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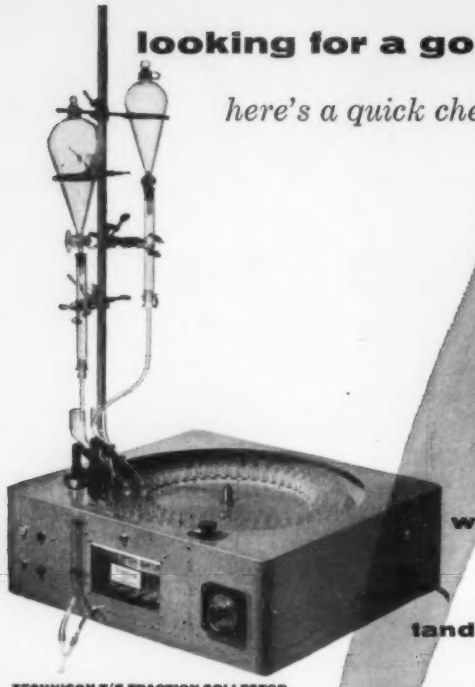

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Attempts at a Unified Theory of Elementary Particles

Hideki Yukawa

Research Institute for Fundamental Physics, Kyoto University, Kyoto, Japan

MODERN atomic theory has been trying to draw as complete a picture of the material world as possible in terms of as few elementary constituents as possible. It seemed that we came closer than ever before to the goal in 1932, when the neutron was discovered. The electrons, protons, and neutrons turned out to be the only constituents of ordinary substances, whereas the photons were associated with the electromagnetic field. The positron was discovered in the same year, but this was welcome as the confirmation of the already successful theory of electrons by Dirac. However, it was clear that the picture was not yet complete. There were two outstanding problems: the beta decay and the nuclear forces. The success of Fermi's theory of beta decay led us to accept the existence of the neutrino, which has been postulated by Pauli. A relativistic field theory of nuclear forces led us further to another new elementary particle. The duality of field and particle seemed to presuppose the existence of the mesons which were to be associated with the nuclear-force field. One type of meson, the mu-meson, was discovered by Anderson and Neddermeyer in 1937 but later turned out to have little, if anything, to do with nuclear forces. Instead, the pi-meson, which was discovered by Powell in 1947, is the one that is responsible for a part, at least, of nuclear forces.

This appeared to be a little too complicated to be accepted as something final, but this was merely the beginning of further complications. Since 1947, unstable particles have been discovered in cosmic rays, in great variety, one after another. Some of them were created artificially by high-energy accelerators. It seems that more and more new particles are discovered as we go further and further in search of the high-energy region. It seems that we are in an open world in the sense that a small number of elementary particles that have been familiar to us are not likely to be the sole elementary constituents of our world but are more likely to be the more stable members of a large family of elementary particles. Of course, there is still room for the argument that most of the newly discovered unstable particles are not elementary but are compound systems that consist of two or more elementary particles in the true sense. However, even if we take such a conservative view of the present situation in the theory of elementary particles, we cannot help asking ourselves the question: What is an elementary particle?

Reexamination of the Concept of Elementary Particle

At first sight, there is no difficulty in defining an elementary particle in mathematical terms. In relativistic quantum mechanics, which was established by 1930 chiefly by Dirac, Heisenberg, and Pauli, the duality of wave and corpuscle is best represented by the concept of quantized field. It is the totality of infinitely many operators $\psi_\alpha(x_n)$, where x_n is a set of space-time parameters and α is an index discriminating the components of a quantity such as a vector or a spinor that transforms linearly under Lorentz transformations. Let us call it a *local* field in order to distinguish it from a *nonlocal* field, which is discussed later. Now, an elementary particle could be defined as one that is associated with an irreducible local field. A field is said to be irreducible if it can no longer be decomposed into parts, each of which transforms linearly by itself under Lorentz transformations. In this way, the *spin* of the elementary particle is defined: For instance, the scalar or pseudoscalar field with only one component is associated with the particles with spin zero, whereas the spinor field is associated with those with spin $\frac{1}{2}$. The commutation relationships between the quantized field quantities determine the statistics of the corresponding assembly of particles.

One of the most attractive features of quantum theory of fields was that it enabled us to deduce the well-known relationship between spin and statistics: The particles with zero or integer spin obey Bose-Einstein statistics, while those with half-integer spin obey Fermi-Dirac statistics. We take it for granted, furthermore, that each type of elementary particle has its unique mass m. The difficulty of the present field theories arises in this connection. Suppose that the free field satisfies the second-order wave equation

$$\left(\frac{\partial^2}{\partial x_n \partial x_n} - \kappa^2\right)\psi_\alpha(x_n) = 0 \qquad (1)$$

as usual, where κ is a constant with the dimension of reciprocal length. Then, of course, the mass of the associated particles is uniquely defined by $m = \hbar/c$ as long as the particles are completely free. However, in the present field theories, one can find no *a priori* reason for choosing one value or another for the constant κ or m. Therefore, what one does is to equate m with the observed mass of the particle in question. However, this again is objectionable because the particle in question is observable for the very reason that it is not free but interacts with other particles.

Thus, the problem of mass of an elementary particle cannot be separated from the problem of interaction between quantized fields. In the usual local field theory, we assume a *local interaction* between local fields. For instance, the effect of another field $\varphi_\beta(x_\mu)$ on the field $\psi_\alpha(x_\mu)$ could be described by adding certain terms to the left-hand side of Eq. 1, which are functions of φ_β and ψ_α at the same space-time point x_μ. If we introduce such an interaction, the mass of the particle that is associated with the field $\psi_\alpha(x_\mu)$ is altered by an amount that is c^{-2} times the self-energy. Unfortunately, the self-energies of particles turned out to be infinite or, at least, indefinite in the known simple cases of local fields with local interactions. This difficulty was known already in 1930, when quantum electrodynamics was established by Heisenberg and Pauli. As a matter of fact, at least a part of this pathological character of quantum theory of fields was inherited from its predecessor, classical electrodynamics. One must admit that the precise definition of the mass of an elementary particle is impossible, unless one is able to get rid of the infinite self-energy somehow.

Mixed Field Theories

The so-called "mixed field theory," which was proposed by Pais and Sakata, is of great interest in this connection. Let us take the familiar case of the electron interacting with the electromagnetic field. The self-energy of the electron owing to the electromagnetic field produced by the electron itself becomes infinite. However, if we assume further that the electron interacts at the same time with another field of appropriate kind in an appropriate manner, we may hope that the self-energy due to the latter interaction just counterbalances the electromagnetic self-energy of the electron so that the resulting self-energy becomes finite. This is actually the case, if we choose as the second field a scalar field, with which neutral spin-zero particles with the rest mass of the order of meson masses are associated, and which interacts with the electron as strongly as the electromagnetic field.

Moreover, if we extend the same idea to the case of the proton, we obtain the correct sign and the correct order of magnitude for the difference of the masses of the proton and the neutron. This seemed to give rise to a new hope of constructing a consistent field theory that would be free of the pathological divergence difficulties, by assuming the coexistence of a number of fields, known and unknown, in such a way that the self-energies of all the particles that were associated with these fields would become finite on account of mutual compensation. Such an attempt was successful to some extent, but there is little hope for arriving at the complete removal of all divergences as long as we hold to the local field theories with local interactions. Namely, the divergence that is related to the so-called "vacuum polarization" in quantum electrodynamics cannot be removed by the assumption of coexistence of various charged particles with different spins. In spite of this, however, the idea of mutual compensation is significant in indicating that the coexistence of various fields and particles is not accidental; rather, one may be able to find cogent reasons for it.

In passing I want to mention that a recent development in quantum electrodynamics originated by Tomonaga, Schwinger, and Feynman was remarkable in that all experimental results so far known were reproduced unambiguously and with great accuracy, but this was possible only after the theoretically infinite masses and electric charge had been replaced by the observed finite masses and charge. Complete justification for this *renormalization* cannot be found in the theoretical framework itself.

Local Fields with Nonlocal Interaction

In connection with the procedure of renormalization, the various types of local interaction between local fields can be divided into two classes. The first class includes all interactions that are renormalizable. The familiar interaction between the charged particle with spin ½ and the electromagnetic field is said to be renormalizable because the renormalization of the masses of the charged particle and photon and of the electric charge is sufficient to derive finite results for all other observable quantities. The scalar or pseudoscalar interaction between the scalar or pseudoscalar meson field and the nucleon, which is familiar in the meson theory of nuclear forces, is also renormalizable. There are a few other interactions that belong to the first class. However, most of the other interactions, such as those between electric and magnetic dipoles and the electromagnetic field or the pseudovector interaction between the pseudoscalar meson field and the nucleon, belong to the second class, because the divergences appearing in these cases cannot be removed by applying the renormalization procedure a finite number of times (*1*).

In this connection, one may raise the question: Is it possible to describe atomic and nuclear phenomena in terms of renormalizable interactions alone? The answer is very likely to be negative. The interaction between the electron-neutrino field and the nucleon field in Fermi's theory of beta decay is known to be, in general, a linear combination of five types of interactions. Among them, the tensor interaction, which is *not* renormalizable, is indispensable in accounting for a number of experimental results. It is not renormalizable, even if we accept the view that the beta decay is not an elementary process but can be decomposed into two stages in which creation and annihilation of a virtual meson of an unknown kind take place. Now, if the interaction between fields is not renormalizable in the ordinary sense, it amounts to the same thing to say that the procedure of renormalization necessitates the introduction without end of higher and higher derivatives of field quantities in the interaction. An interaction that involves derivatives of arbitrary order of field quantities is equivalent to a *nonlocal interaction*—that is, an interaction that refers to two or more field quantities at different

space-time points. In other words, the introduction of a nonlocal interaction in field theories can be regarded as a revival of the theory of action at distance that was thought to be contradictory to the notion of field itself in classical physics. However, in the quantum theory of fields, this may not be so, because the notion of the quantized fields seems to be more flexible, field and particle being two aspects of the same physical object (*2*).

Let us consider, for example, the case of a nonlocal interaction between the scalar (or pseudoscalar) meson field $u(x_\mu)$ and the nucleon field $\psi_\alpha(x_\mu)$. The field equations can be written, in general, in the form

$$\left(\frac{\partial^2}{\partial x_\mu'' \partial x_\mu''} - \kappa^2\right) u(x'') = \int \sum_{\alpha,\beta} \overline{\psi}_\alpha(x') \Phi_{\alpha\beta}(x', x'', x''') \psi_\beta(x''') dx' dx''', \quad (2)$$

$$\sum_\beta \left(\gamma_\mu \frac{\partial}{\partial x_\mu'} + M\right)_{\alpha\beta} \psi_\beta(x') = -\int \sum_\beta \Phi_{\alpha\beta}(x', x'', x''') u(x'') \psi_\beta(x''') dx'' dx''', \quad (3)$$

where κ and M are masses of the meson and nucleon in units of $\hbar/c$, and γ_μ are Dirac matrices, $\Phi_{\alpha\beta}(x', x'', x''')$ is a matrix with four rows and columns, each matrix element being a function of three space-time points x', x'', x'''. The most general nonlocal interaction as characterized by arbitrary three-point functions $\Phi_{\alpha\beta}(x', x'', x''')$ reduces to the familiar local scalar coupling, if $u(x)$ is a scalar field and

$$\Phi_{\alpha\beta}(x', x'', x''') = g\, \delta_{\alpha\beta}\, \delta(x' - x'')\, \delta(x'' - x'''),$$

where g is the coupling constant. Similarly, it reduces to local pseudoscalar coupling, if $u(x)$ is a pseudoscalar field and

$$\Phi_{\alpha\beta}(x', x'', x''') = g\, (\gamma_5)_{\alpha\beta}\, \delta(x' - x'')\, \delta(x'' - x''').$$

The quantization of the fields can be carried out as usual. However, an essential departure from the local interaction theory is inevitable on account of the absence of a Schrödinger equation as such for the whole system in nonlocal interaction theory. The role of the Schrödinger equation was to determine uniquely the Schrödinger function or the probability amplitude at any time instant t in terms of the function at the immediately preceding instant $t - dt$. This was possible in the usual field theory, because the Hamiltonian $H(t)$ for the whole system depended only on the field quantities at the instant t. Once we introduce a nonlocal interaction in a relativistically invariant manner, we can no longer have a Hamiltonian that satisfies the afore-mentioned requirement. We really do not know what would be the substitute for the Schrödinger equation, or anything about any final formulation of nonlocal theories.

We know, however, that there is a formulation of ordinary field theory which seems to be suited for extension to nonlocal theories. Namely, one can define an S-matrix, which characterizes the statistical relationship between the possible results of experiments at a remote future ($t \to +\infty$) and the given results of experiments in the remote past ($t \to -\infty$), in terms of Schrödinger functions at $t = +\infty$ and $t = -\infty$ in quantum mechanics. Heisenberg pointed out that the S-matrix might well remain significant in future theories of elementary particles, whereas the Schrödinger function itself might be removed from the picture. In fact, the field equations in nonlocal interaction theory, Eqs. 2 and 3, can be integrated directly by using the same method of successive approximation as is used in ordinary field theory, which enables us to construct the S-matrix as a series in powers of the coupling constant. The trouble with local field theories with local interactions was that each term in the power series for the S-matrix was infinite because of infinite self-energies and some other infinite quantities. Recently, Møller and Kristensen have shown that, if we choose the *form function* $\Phi_{\alpha\beta}(x', x'', x''')$ in nonlocal interaction theory suitably, the self-energies of both the meson and the nucleon become finite, at least in the first approximation. In other words, the masses of these particles could be renormalized without getting into trouble of divergence. This gives us a new impetus to proceed further in this direction.

Nonlocal Fields

The introduction of nonlocal interaction between local fields was the first step toward the solution of the problem of masses of elementary particles. However, another step must be taken, if we want to approach nearer to a unified theory of elementary particles. The concept of a *nonlocal field* (*3*) was introduced in order to describe relativistically a system that was elementary in the sense that it could no longer be decomposed into more elementary constituents but was so substantial, nevertheless, as to be able to contain implicitly a great variety of particles with different masses, spins, and other intrinsic properties. For instance, a nonlocal scalar field is defined as a scalar function that depends on two sets x', x'' of space-time parameters and can be written as

$$(x_\mu' \mid \varphi \mid x_\mu'') \equiv \varphi(X_\mu, r_\mu),$$

where

$$X_\mu = \tfrac{1}{2}(x_\mu' + x_\mu''), \qquad r_\mu = x_\mu' - x_\mu''.$$

The free field equation is supposed to have the general form

$$F(\partial/\partial X_\mu, r_\mu, \partial/\partial r_\mu)\varphi(X_\mu, r_\mu) = 0, \quad (4)$$

where the operator F is a certain function of $\partial/\partial X_\mu$, r_μ, and $\partial/\partial r_\mu$, which is invariant under any inhomogeneous Lorentz transformation. In particular, if we assume that F is linear in $\partial^2/\partial X_\mu \partial X_\mu$ and separable —that is,

$$F \equiv -\frac{\partial^2}{\partial X_\mu \partial X_\mu} + F^{(r)}\left(r_\mu r_\mu, r_\mu \frac{\partial^2}{\partial r_\mu \partial r_\mu}, r_\mu \frac{\partial}{\partial r_\mu}\right), \quad (5)$$

then we have eigensolutions of the form $\varphi \equiv u(X)\chi(r)$, where u and χ satisfy

$$[\partial^2/\partial x_\mu \partial x_\mu - \mu]u(X) = [F^{(r)} - \mu]\chi(r) = 0, \quad (6)$$

μ being the separation constant. Thus, the masses of the free particles, which are associated with the non-

local field φ, are given as the eigenvalues of the square root of the operator $F^{(r)}$ which characterizes, so to speak, the internal structure of the elementary nonlocal system. If one chooses the square root of the operator $F^{(r)}$ such that the eigenvales $\sqrt{\mu_n} = m_n$ are all positive and discrete, one can expand an arbitrary nonlocal field into a series of internal eigenfunctions $\chi_n(r)$:

$$\varphi(X, r) = \sum_n u_n(X)\chi_n(r). \tag{7}$$

Now, when the nonlocal scalar field $(x' \mid \varphi \mid x'')$ interacts, for instance, with a local spinor field $\psi_\alpha(x_\mu)$, the field equations become

$$\left(\frac{\partial^2}{\partial X_\mu \partial X_\mu} + F^{(r)}\right)\varphi(X, r) = -g\sum_\alpha \psi_\alpha\left(X + \frac{r}{2}\right)\overline{\psi_\alpha}\left(X - \frac{r}{2}\right); \tag{8}$$

$$\left(\gamma_\mu \frac{\partial}{\partial x_\mu'} + M\right)\psi(x') = -g\int (x' \mid \varphi \mid x'')\psi(x'')dx''. \tag{9}$$

We insert Eq. 7 in Eq. 8, multiply both sides by the complex conjugate of χ_n, and integrate over the four-dimensional r-space, provided that $\chi_n(r)$ is quadratically integrable and, therefore, is normalized. The result is

$$\left(\frac{\partial^2}{\partial x_\mu'' \partial x_\mu''} - m_n^2\right)u_n(x_\mu'') = \int \Phi_n(x', x'', x''')\sum_\alpha \overline{\psi}_\alpha(x')\psi_\alpha(x''')\,dx'dx''', \tag{10}$$

where

$$\Phi_n(x', x'', x''') \equiv g\,\overline{\chi}_n(x' - x''')\,\delta\frac{x' + x'''}{2}\left(-x''\right). \tag{11}$$

Similarly, we obtain from Eq. 7 the equation

$$\left[\gamma_\mu \frac{\partial}{\partial x_\mu'} + M\right]\psi(x') = -\int \tilde{\Phi}_n(x', x'', x''')u_n(x'')\psi(x''')dx''dx'''. \tag{12}$$

If we compare them with the field equations, Eq. 2 and Eq. 3, of the case of nonlocal interaction between local scalar and spinor fields, we notice that the internal eigenfunction $\chi_n(r)$ characterizes the form function for the particle with mass m_n. The essential difference between the theory of nonlocal field and that of nonlocal interaction is that, in the former case, we have to take into account simultaneously all the particles with different masses m_n that are derived from an eigenvalue problem. Furthermore, the form function for each of these particles is uniquely determined by the same eigenvalue problem.

The foregoing general considerations can be illustrated by assuming a very simple form

$$F \equiv -\frac{\partial^2}{\partial X_\mu \partial X_\mu} + \frac{\lambda^2}{2}\left(-\frac{\partial^2}{\partial r_\mu \partial r_\mu} + \frac{1}{\lambda^4}r_\mu r_\mu\right)^2, \tag{13}$$

where λ is a small constant with the dimension of length. One may call this the four-dimensional oscillator model for the elementary particle. It was considered first by Born (*1*) in connection with his idea of self-reciprocity. However, our model differs from his in that the internal structure of the particle appears explicitly in our case in connection with the nonlocalizability of the field itself. One can easily see that the mass spectrum for our case is discrete and is given by

$$m(n_1, n_2, n_3, n_0) = 2^{1/2}\lambda^{-1}\mid n_1 + n_2 + n_3 - n_0 + 1 \mid, \tag{14}$$

where n_1, n_2, n_3, and n_0 are zero or positive integers. The main trouble with the four-dimensional eigenvalue problems is the infinite degeneracy. The theory will be necessarily more complicated, if we try to get rid of this difficulty. In any case, what has been discussed here (*5*) is just the beginning of an attempt, which may lead us to a possible formulation of a unified theory of elementary particles, if we are lucky.

In conclusion, let me say that there are a number of important points that are not discussed here at all. One is the validity of the weak coupling approximations in the theories of elementary particles. We are well aware of the limitations of such approximations in connection with the problem of nuclear forces, but we cannot depart from it easily, simply because we do not have yet any satisfactory *relativistic* theory of quantized fields which is free from the assumptions of weak coupling.

References and Notes

1. Relationships between mixed field theory and nonlocal interaction theory have been discussed extensively by A. Pais and G. Uhlenbeck [*Phys. Rev.* **79**, 145 (1950)]. As for the classification of local interactions according to their renormalizability or unrenormalizability, refer to S. Sakata, H. Umezawa, and S. Kamefuchi, *Progr. Theoret. Phys. (Japan)* **7**, 377 (1950); H. Umezawa, *ibid.* **7**, 551 (1950).
2. Theories of local fields with nonlocal interactions have been discussed by many authors. Most recent of these papers are C. Bloch, *Danske Videnskab. Selskab* **27**, No. 8 (1952); P. Kristensen and C. Møller, *ibid.* No. 7.
3. H. Yukawa, *Phys. Rev.* **77**, 219 (1950); **80**, 1047 (1950); **91**, 415, 416 (1953).
4. M. Born, *Revs. Mod. Phys.* **21**, 463 (1949).
5. This article is based on a lecture given at the third meeting of Nobel prize winners in Lindau, Bodensee, 2 July 1953.

I have no economic radar to penetrate the future, but we can make it what we will it to be. Of that I am sure.—BERNARD BARUCH.

Apparatus for Carbon-14 Dating

C. Ballario, M. Beneventano, A. De Marco*
National Nuclear Physics Institute, The University, Rome

F. Magistrelli
Physical Institute, The University, Rome

C. Cortesi, T. Mantovani
Geochemical Institute, The University, Rome

THROUGH the collaboration begun at the end of 1951 between the Physical and Geochemical Institutes of the University of Rome, a laboratory is now ready to begin its dating activity by the carbon-14 method. The object of this paper (*1*) is to describe the characteristics and working of the apparatus, which is now complete, and which was only briefly mentioned in an earlier note (*2*) when it was still in the development and testing stage.

We wish to state beforehand that the method used in this laboratory is fundamentally the same as that developed by W. F. Libby and his colleagues (*3, 4*) that is, we carry out measurements on elementary carbon in a screen-wall counter. However, several important modifications have been made in the technique of preparing the radiochemically pure carbon, and in particular in the technique of measuring the radioactivity of the C^{14} isotope with the development of a four-element counter. This arrangement allows the simultaneous measurement of four samples of different specific activity. As will be seen, this procedure tends to eliminate some possible systematic errors of measurement.

Preparation of samples. The preparation of radiochemically pure elementary carbon from materials of animal or vegetable origin follows the main ideas of the method developed by Libby and his colleagues (*3, 4*). We have made no fundamental modifications in the cycle of chemical reactions involved in this method; however, we have found it useful, from the beginning of our experiments, to make several important modifications in the technique, thus obtaining a somewhat different apparatus from that used by Libby *et al.* Our most important modifications are as follows.

1) In experimenting with noncarbonized materials (for example, wood), a carbonization is carried out by heating the sample in a closed crucible, followed by treatment with hydrochloric acid.

In carrying out the first reaction cycle (that is, combustion of the sample in a current of oxygen, reaction of the carbon dioxide thus produced with aqueous ammonia solution, and precipitation of calcium carbonate by addition of calcium chloride) we eliminated the liquid nitrogen "traps" used by Libby *et al.* to solidify the carbon dioxide before passing it into the ammonia solution. We consider this operation superflous; it does not contribute to the purification of the carbon dioxide nor does it seem to be particularly useful for regulating the absorption of this gas in the ammonia solution. In fact, if the carbon dioxide is passed directly into the ammonia solution, the oxygen current being suitably regulated, a regular and complete absorption with an almost theoretical reaction yield is obtained. This was verified by absorbing carbon dioxide produced from very pure calcium carbonate.

The simplified apparatus consists of (i) an oxygen source, (ii) bottles for purifying and drying the oxygen, (iii) an electrically heated quartz combustion tube, (iv) a second quartz tube containing filings of oxidized copper mixed with lead chromate and with silver gauze for completion of combustion, (v) additional bottles for purifying and drying, (vi) bulbs of Jena glass containing aqueous ammonia solution in which the absorption of carbon dioxide and the precipitation and washing of calcium carbonate takes place.

2) The second reaction cycle consists in producing carbon dioxide by treating the calcium carbonate prepared in the first reaction cycle with hydrochloric acid and reducing it to elementary carbon by means of metallic magnesium. This cycle is not carried out at reduced pressure. This involves considerable simplification and modification of the apparatus, which consists essentially of a Kipp's apparatus containing the calcium carbonate and hydrochloric acid connected by bottles for washing and drying to one end of an electrically heated stainless steel tube containing magnesium, at the other end of which is a stopper furnished with a tap. The tap is kept open, and a slightly lowered pressure is maintained across it during the preparatory stage, that is, before starting to heat the tube. In this way the whole apparatus is first filled with air free of carbon dioxide and suitably purified of radon, and then it is filled with the carbon dioxide produced in the Kipp's apparatus.

With this simple apparatus, when the reduction reaction ($2Mg + CO_2 \rightarrow 2MgO + C$) is started by the heating, an automatic but controllable flow of carbon dioxide is set up from the Kipp's apparatus to the steel tube; this flow proceeds regularly with the reaction and ceases when the reaction ceases. The reac-

tion can be made to occur rapidly and we consider its yield, about 85 percent of the theoretical, to be satisfactory.

3) To eliminate the magnesium oxide and excess metallic magnesium obtained during the reduction reaction, we kept the procedure suggested by Libby practically unchanged. We found it convenient, however, to prolong the period of digestion in boiling concentrated hydrochloric acid and to alternate three treatments with this acid with thorough washing with distilled water and partial drying of the sample. By following this procedure we almost always obtain carbon with a satisfactorily low ash content, varying between 2 and 0.5 percent. The final drying of the carbon takes place at 125°C and the sample, still hot, is put in a hermetically sealed bottle for storage.

The sample is ground in an agate mortar that is placed in a kind of transparent, hermetically sealed box. The operator puts his hands, protected by gloves, into this box. The samples are ground and the ash and carbon content are determined at the time when the samples are taken out of the box to be spread on the sample holders of the counter. This last operation is particularly laborious because of the special form of the sample holders.

4) As already indicated, this method for carbon dating involves relative and simultaneous measurements of the activity of four different samples. It is therefore necessary to prepare the four samples in experimental conditions as nearly identical as possible, and, in particular, to have available beforehand a single quantity of each reagent that will be sufficient for all the four preparations.

Of the four samples used, two are to be dated; the activities of these two are compared with those of the remaining two samples, one of which is active carbon prepared from contemporary charcoal, and the other of which is old inactive carbon prepared from a very pure metamorphic crystalline saccharoid limestone (white marble from Carrara) of Secondary Era, attributed today to lower Lias. This limestone is subjected to the same chemical cycle of purification to which all the materials containing carbon are subjected, except, of course, that a hydrochloric acid treatment in the Kipp's apparatus is substituted for the initial combustion. The carbon prepared from this limestone was shown, in a control experiment, to be as inactive as carbon prepared from anthracite. We prefer to use it because the preparation is much simpler.

Method of counting and dating. The counting arrangement (Fig. 1) consists of a Geiger counter with four elements, facing each of which is one of the four samples. Each element is followed by a recording channel. The cylindrical armature constituting the four elements can rotate about its axis A; another fixed cylindrical armature, coaxial with the first and supporting the samples, ensures that the latter face the four elements of the counter.

On the sample holder cylinder samples of active and inactive carbon, and two samples to be dated, are mounted on copper supports. Each channel measures the activity of one of the samples, and the pulses of the four channels are recorded contemporaneously on four mechanical counters. By rotating the cylinder about its axis at equal time intervals, all four samples are brought one after another to face each element of the counter. Each channel thus gives data sufficient for dating the samples of unknown ages, and the four values obtained for each of these ages must coincide within experimental error before they are used to obtain a final mean value.

As Crane has clearly shown (*5*), the dating method based on comparing the activity of an unknown sample with the activity of both an active and an inactive sample has an important advantage over Libby's classical method because it eliminates the necessity of knowing the absolute efficiency of the counter and of being sure of the constancy of its characteristics between one run and another. The method used by Anderson *et al.* (*6*) does not compare the activity of an unknown sample with the activity of both an active and an inactive sample in each run, but, like our arrangement, it allows dating on several independent channels.

Four-element grid counter and recording apparatus. Figure 1 shows a schematic section of the four-element grid counter. The relative rotation of the sample holder cylinder P with respect to the four elements is effected by means of a weight and the movement takes place on ball bearings. The walls W separating the elements are 0.1 mm thick, that is, thick enough to absorb all the electrons emitted by the C^{14}. The area covered by carbon is 450 cm², so that 9 g of carbon are sufficient to give a layer of infinite thickness.

The filling of the counter consists of argon and butane: the partial pressure of the butane is 1 cm-Hg and the total pressure of the mixture is 10 cm-Hg. The butane is commercial grade and the argon is standard grade further purified of oxygen. The grids are maintained at a potential of +45 v with respect to the sample holders. The counter is screened from surrounding radioactivity and from the soft compo-

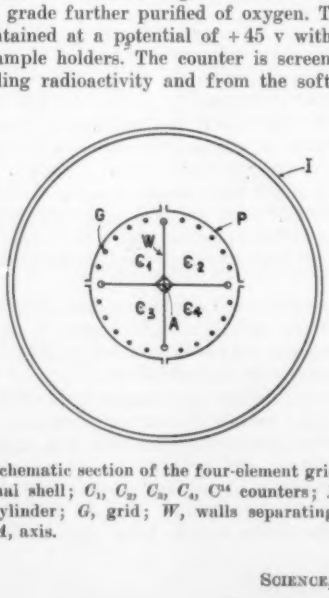

Fig. 1. Schematic section of the four-element grid counter. I, external shell; C_1, C_2, C_3, C_4, C^{14} counters; P, sample holder cylinder; G, grid; W, walls separating the elements; A, axis.

nent of cosmic rays by a screen of at least 20 cm of iron, and it is screened from the penetrating component of cosmic rays by a complete cover of anticoincidence counters 80 cm in length.

Figure 2 is a block diagram of the apparatus. A quenching circuit Q with a suitable time constant is connected to each of the four Geiger elements and to the Geiger counters of the anticoincidence cover. This prevents the spontaneous onset of a secondary discharge in an element after there has been a first discharge caused by an ionizing particle. The anticoincidence arrangement cannot eliminate these spurious pulses that would disturb the measurements if the quenching circuits were omitted. The circuits A_1, A_2, A_3, A_4, and A_r amplify and invert the pulses. The circuit S emits a pulse every time two or more pulses, each coming from one of the circuits A, enter it simultaneously. Each of the circuits N_1, N_2, N_3, and N_4 operates corresponding mechanical counter every time it receives a pulse from circuit A_1, A_2, A_3, or A_4 not accompanied by a pulse from S. There is, thus, in addition to an external anticoincidence for the cosmic rays, a local anticoincidence of each of the four elements with respect to each of the others. This eliminates both the cosmic ray pulses caused by the imperfect efficiency of the anticoincidence shield and the pulses from electrons created by γ-rays in the counter that pass through the dividing walls between element and element.

The background is 15.5 counts/min. We think that this high background rate is largely the result of the α-radioactivity of the exposed copper surfaces of the counter. It was found that a sample holder of exposed metal is more active than an infinitely thick layer of inactive carbon. The carbon layer eliminates the α-activity of the metallic surfaces. The possibility of reducing the background resulting from this cause is being examined.

Analysis of data. The data furnished by each channel were analyzed in the following way. A camera photographed the mechanical counters at brief regular intervals of time, and the counts registered in each interval were analyzed statistically. This analysis showed that in general the counts obeyed a Poisson distribution, and gave reason to suppose that the fluctuations in counting rate were caused almost entirely by the randomness of the β-decay. Nevertheless in some intervals the number of counts observed was greater than the mean by more than three times the mean square deviation, and the number of such intervals was somewhat greater than that to be expected from a pure Poisson distribution. This effect was attributed to occasional spurious discharges caused by small solid particles deposited on the counter wire. We consider it wise, therefore, to accept only those counts that differed from their mean by not more than twice the mean square deviation. In this way we felt secure that any such spurious discharges would not influence our mean value for the counting rate caused by C^{14} decay electrons; this method produced, in the mean square deviation of the age of the sample, an error of barely 2 percent.

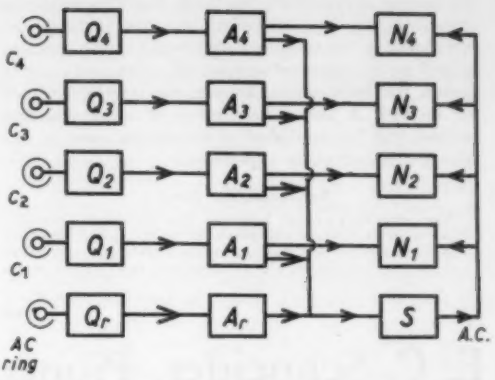

Fig. 2. Block diagram of the counting apparatus. Q, quenching circuits; A, amplifier and inverter circuits; N, operating circuits for mechanical counters; S, local anticoincidence circuit.

Each channel thus gave a value for the age of the sample and the mean of these was taken as the final result; the standard error was calculated from those of the separate values using the Gauss method.

These four separate values, obtained from 12 hr of counting, have always been in excellent agreement among themselves, within the limits of purely statistical error, and we therefore consider that any possible error caused by an imperfect functioning of the apparatus is entirely negligible, and that by increasing the counting time we can reduce still further the standard error of the final result.

The value found for the age is corrected for the different percentages of ash contained in the various samples. It is not necessary to correct for volatile substances adsorbed by the carbon because these, with the method used, would have the same effect on all the samples compared, and this effect is canceled in the analysis of the measurements.

Conclusions. We carried out control measurements using two samples of ages well estimated by other means. One of these samples was prepared from a piece of wood from the Roman ships at the Lake Nemi (Rome), the construction of which is attributed to the Emperor Caligula (A.D. 37–41). The result of our measurement gave 2030 ± 200 yr. The second sample was prepared from charcoal found in an Etruscan tomb near Cerveteri, Italy. The historical age is about 2600 yr. Our measurement gave 2730 ± 240 yr.

These results were obtained after 48 hr of acceptable counting (12 on each channel for each sample) without taking into account the few measurements excluded as having too large a deviation.

Active carbon gives an effect of 5.43 ± 0.12 counts/min above background. This number does not represent an essential datum for us because for each run the count of the unknown sample is compared simultaneously with the count of the active and inactive carbons.

On the basis of the satisfactory results obtained in

the control experiments, we think that this technique for measuring the activities, and the modifications introduced in the technique of preparing the samples, as well as the choice of samples of active and inactive carbon for comparison, answer the requirements of the method. A fuller description of apparatus and method will be published elsewhere as soon as we have completed other experiments.

References and Notes

* New address, Physical Institute, The University, Genova.

1. We wish to express our gratitute to E. Amaldi, director of the Physical Institute of Rome University, and to G. A. Blanc, director of the Geochemical Institute of Rome University, for their encouragement and advice; to E. Persico for many useful discussions; and to F. Lepri for his suggestions for the perfection of the electronic circuits. We also wish to express our thanks to the Consiglio Nazionale delle Ricerche which furnished the greater part of the funds necessary for the experiment, and to the S. A. TERNI, which placed at our disposal the large quantity of iron necessary for the screening of the counter.

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E. C. Schneider, Pioneer in Aviation Medicine

As a leader in studies of the physiological effects of high altitudes and of the physiology of physical fitness, Edward Christian Schneider became a pioneer in the establishment of modern aviation medicine. Beyond this, however, he was a great teacher of college undergraduates, who have acknowledged his influence not only in their personal tributes to him but also in the records of their careers in the fields of zoology, human physiology, public health, and medicine.

Ed Schneider, as he was familiarly known to his friends, was born (21 August 1874) and brought up in Iowa. He graduated from Tabor College in 1897 and taught there as an instructor in chemistry for 2 years immediately following his graduation. He then entered the graduate school at Yale University to study biochemistry under Lafayette B. Mendel and physiology under Yandell Henderson; he received his Ph.D. degree in 1901. His thesis and first published papers were in the field of biochemistry. Schneider then returned to Tabor College for two more years as professor of biology and physiological chemistry. During this period he married Elsie M. Faurote, who, with his two children and six grandchildren, now survives him.

In 1903 he accepted a position at Colorado College, where he remained for 15 years as head of the department of biology. Here he resumed his researches in biochemistry and also wrote two papers on botanical ecology which resulted from his interests and explorations stimulated by his teaching of botany. Of greater future significance, however, was the beginning, in 1904, of his researches on Pikes Peak on the physiological effects of high altitudes. In 1911 he was a member of the distinguished Anglo-American team, consisting of G. Gordon Douglas, J. S. Haldane, Yandell Henderson, and Schneider, that met in Colorado to continue these investigations. The results of these studies proved to be a landmark in this phase of human physiology.

In 1917, soon after the United States entered World War I, Dr. Schneider was called to Washington, D.C. by the Medical Research Board that had been established by General Gorgas to oversee the development of low-oxygen tests for aviators and later to supervise the physical examination of aviators. For this duty he was first commissioned a captain and soon was promoted to a major in the Sanitary Corps, U.S. Army. The work was shifted to Hazelhurst Field on Long Island, where, under Schneider as officer in charge of physiological research, tests of ability to withstand high altitudes were devised and personnel were trained to administer these tests at flying fields throughout the country. By March 1918 a school for flight surgeons was demanded. Dr. Schneider designed the first curriculum and, in this way, began the development that later led to schools of aviation medicine.

In July 1918 a summons came from General Pershing for men trained in the Hazelhurst School. Thirty-three officers and men headed by a research board of four, of which Major Schneider was a member, embarked on 6 August for service with the American Expeditionary Force. A laboratory was set up in Issoudan in France, with Schneider as officer in charge of physiological work. Here he not only worked in the laboratory but also went on flights with the aviators to experience the actual conditions. It was here that the Schneider test for physical fitness, which became widely used in the selection of aviators, was developed; its use continued through World War II and later. After 6 months in the European theater he returned to Hazelhurst Field and was discharged from service; later he became a lieutenant colonel in the reserve. However, from September 1919 until 1925, he continued in a civilian capacity as director of research at the School of Aviation Medicine that had been established at Mitchell Field.

It was also in 1919 that he accepted appointment as Daniel Ayres professor of biology at Wesleyan University. For 6 years he carried the double load, spending 2 days a week and vacations at Mitchell Field. At Wesleyan he became almost immediately one of the most influential members of the faculty. His teaching was in the fields of elementary biology, bacteriology, physiology, and public health. When the Shanklin Laboratory of Biology was erected in 1928, many of

his ideas were incorporated in its design. After 1926 his research activity was transferred to Wesleyan University and centered especially on problems of physical fitness. This included studies on the effects of training of athletes, the physiology of the adolescent boy, and some studies on laboratory mammals. In 1933 he published a survey of his field of interest under the title *The Physiology of Muscular Activity*. This book has now gone through three editions. Schneider contributed about 50 articles on his basic research, most of which were published in the *American Journal of Physiology*. The balance of his 75 publications include review articles and a variety of other topics.

Possibly even more important than his research achievements was Schneider's influence on his students. This is attested by the striking proportion who went on to distinguished careers in such diverse fields as zoology, parasitology, preventive medicine, public health, physiological research, and medical-school administration. His unusual success in the training of premedical students was noted when he was at Colorado College and at Wesleyan University. His students were impressed with his scholarship, his exacting standards, and his earnestness in instruction. As they came to know him better, they became aware of his warm personal sympathy, and many students came to him with their most intimate problems.

Dr. Schneider's interests extended beyond the college to the local community and to the state. He was a member of the Exchange Club and a director of the Middlesex Hospital, and he was active in the affairs of the Nurses' School and in his church. He was a director of the State Experiment Station at New Haven.

Public recognition of his achievements is shown in the conferment on him of the M.P.E. degree by the International Y.M.C.A. College in 1923 and the honorary D.Sc. degrees by the University of Denver in 1914 and by Colorado College in 1932. In 1942 he received the John Jeffries award from the Institute of Aeronautical Sciences for outstanding contributions to the advancement of aeronautics through medical research. Perhaps most gratifying to him, however, was the receipt of more than 150 letters, chiefly from former students, on his 70th birthday. When he reached the formal age of retirement at 68, Wesleyan University accorded him the unusual recognition of an appointment to a university professorship and retained his services into his 71st year.

Dr. Schneider died 3 October 1954. Members of the college, the local community, and many others have lost an unassuming friend who could always be counted on for support and wise counsel and who, in their memory, will always be an inspiration.

H. B. GOODRICH

Shanklin Laboratory, Wesleyan University
Middletown, Connecticut

Henry K. Benson, Wood Chemist

HENRY KREITZER BENSON, emeritus professor of chemical engineering and retired chairman of the department of chemistry and chemical engineering at the University of Washington, Seattle, died on 27 September 1954.

He was born on 3 January 1877 in Lebanon, Pennsylvania, attended schools in Pennsylvania, and received his B.A. degree in 1899 and his M.A. degree in 1902 from Franklin and Marshall College in Lancaster. In 1903 and 1904, he continued graduate study at Johns Hopkins University in the field of chemistry under the guidance of Remsen. In 1904, he was appointed assistant professor of chemistry at the University of Washington, thus beginning an association with this university that continued for 50 years. During 1906 and 1907, he was on leave from Washington and continued his graduate study at Columbia University, which in 1907 granted him the Ph.D. degree. Dr. Benson then resumed his work at the University of Washington and in 1919 was made professor and head of the department of chemistry and chemical engineering.

In 1926, Franklin and Marshall College bestowed upon him the honorary D.Sc. degree. Dr. Benson served as chairman of the Division of Chemistry and Chemical Technology of the National Research Council in 1931–32, and during this year wrote *Chemical Utilization of Wood*. In 1938 he was a delegate to the International Conference of Chemistry in Rome, Italy.

Dr. Benson was a member of the American Chemical Society, American Institute of Chemical Engineers, Technical Association of the Pulp and Paper Industry, and many other organizations. He was instrumental in bringing about the organization of the Pacific Section of the Technical Association of the Pulp and Paper Industry which held its first meeting at the University of Washington in 1928. He was author of a textbook, *Industrial Chemistry for Engineering Students*. Throughout his life, he contributed more than 100 papers concerned with wood chemistry, chemical engineering, and other subjects. Problems related to the pulp and paper industry were of special concern to Dr. Benson, and in recent years several of his papers have dealt with the pulping of woods by ammonium bisulfite solutions and with various aspects of sulfite-spent liquor. In 1947 he retired from his administrative and active academic duties but continued to serve the university as professor emeritus of chemical engineering and as research consultant.

JOSEPH L. MCCARTHY

University of Washington, Seattle

News and Notes

NSF Summer Institutes for Teachers of Mathematics and Science

During the past two summers the National Science Foundation has supported "summer institutes" designed to help teachers of science and mathematics increase their competence. In these institutes teachers from high schools and the smaller liberal arts colleges and universities—especially those remote from centers of research—have gathered together to learn, from persons noted for both scholarship and skill in exposition, about some of the more important and recent concepts and methods in their fields. It has been hoped that these teachers, armed with new information and insights and enthusiasms, could then return to their colleagues and students and think anew with them about teaching materials, methods, and objectives in the light of modern scientific research.

In the summer of 1953 two such institutes for college teachers were supported by the foundation: one in mathematics at the University of Colorado, and one in physics at the University of Minnesota. In the summer of 1954 four were supported. Of the four, three were again for college teachers: one in mathematics at the University of North Carolina, another in mathematics at the University of Oregon, and one in chemistry at the University of Wyoming. (In three instances the Fund for the Advancement of Education supported concurrent institutes for high-school teachers: at Minnesota in 1953, and at Oregon and Wyoming in 1954.) The fourth, for high-school teachers of mathematics, was held at the University of Washington.

The typical summer institute differs from both the typical academic summer session and the typical summer workshop in several important respects. The staff is not local in character but is selected from a wide geographic region, generally from the country at large. The emphasis is on subject matter, yet with a view to increasing the competence of teachers as teachers, not as research workers. The program may combine both extended series of lectures by a few people and short series by many, but the institute is long enough (4 to 8 weeks) and well enough coordinated to constitute a significant educative experience for the participants.

It has been thought important to locate institutes on campuses that have climates conducive to summer work, and to provide adequate recreational activities for participants and their families. Every attempt has been made to secure living quarters for all participants, including families and staff, that will foster the extended informal contacts and conversations deemed so important by members of past institutes.

The expenses of some participants have been paid by their home institutions, and some have attended at their own expense; but, in the case of every institute, funds have been provided for modest stipends to enable 20 to 30 persons to attend who could not otherwise afford to do so. In some instances no academic credit has been offered for the work done, in others optional credit has been provided at a reasonable cost, and in still others a certificate of attendance has been issued. In all cases applications for membership and stipends are issued and handled by the college or university conducting the institute.

In the summer of 1955 nine institutes will be supported by grants from the National Science Foundation. Their locations, the groups they are designed to serve, and *the persons to whom all inquiries about them should be addressed* are as follows.

University of Minnesota, for college teachers of chemistry; Robert C. Brasted, Dept. of Chemistry, University of Minnesota, Minneapolis 14.

University of New Mexico, for high-school and college teachers of physics; John R. Green, Dept. of Physics, University of New Mexico, Albuquerque.

Oak Ridge Institute of Nuclear Studies, for high-school teachers of science; Ralph T. Overman, Special Training Division, Oak Ridge Institute of Nuclear Studies, Inc., P.O. Box 117, Oak Ridge, Tenn.

Oklahoma Agricultural and Mechanical College, for college teachers of mathematics; L. Wayne Johnson, Dept. of Mathematics, Oklahoma A. and M. College, Stillwater.

Pennsylvania State University, for high-school teachers of science; William H. Powers, Arts and Science Extension, Pennsylvania State University, University Park.

Stanford University, for college teachers of mathematics; Harold M. Bacon, Dept. of Mathematics, Stanford University, Stanford, Calif.

Syracuse University, for college teachers of chemistry; Henry E. Wirth, Dept. of Chemistry, Syracuse University, Syracuse 10, N.Y.

University of Wisconsin, for high-school and college teachers of mathematics; C. C. MacDuffee, Dept. of Mathematics, University of Wisconsin, Madison 6.

University of Wyoming, for college teachers of biology; William B. Owens, Dept. of Zoology, University of Wyoming, Laramie.

More detailed information about several of the institutes appears in *Science*, 18 Feb., page 239; 11 Mar., page 358; and elsewhere in this issue. Details concerning others will appear in forthcoming issues.

The National Science Foundation expects to continue and hopes to expand its program of summer institutes in 1956. Proposals from colleges and universities for funds in support of 1956 institutes should be received at the foundation office not later than 1 Oct. 1955. *All proposals for 1956 or inquiries preliminary to them should be addressed to*: Program Director of Education in the Sciences, Division of Scientific Personnel and Education, National Science Foundation, Washington 25, D.C.

HARRY C. KELLY
National Science Foundation, Washington 25, D.C.

Indian Science Congress

The 42nd Indian Science Congress was held at Baroda under the auspices of the M. S. University, Baroda, 4–10 January 1955. Shri Jawaharlal Nehru, Prime Minister of India, opened the congress. About 5000 visitors, including 2000 delegates attended the Session.

At the opening session S. K. Mitra, president of the session, feelingly referred to the sudden and sad demise of S. S. Bhatnagar, secretary to the Government of India, Ministry of Natural Resources and Scientific Research, and director, Council of Scientific and Industrial Research, a past general president and an honorary member of the Indian Science Congress Association. The audience stood in silence for 1 minute when business of the ceremony commenced.

Welcoming the scientists and other visitors to the session, Hansa Mehta, vice chancellor, M. S. University, and chairman of the local reception committee, made an appeal for the application of science in the service of man so that the destructive potentiality of science could be usefully converted to doing good for people.

In his short inaugural address Shri Jawaharlal Nehru exhorted the scientists to coordinate activities and render all help in framing the 2nd National Five-Year Plan for improvement of the conditions of people.

P. C. Mahalanobis introduced the guests from countries abroad, numbering about 60, to the audience. Mitra emphasized the need for application of modern scientific methods in the industrial sphere with a view to raising the production and making things available to consumers at lower prices.

The scientific business of the session was carried on in 13 different sections, representing different branches of science. More than 1000 papers were presented and read. Twenty-nine symposiums on different scientific aspects and problems were held in the 13 sections. The following popular lectures were given: "Symmetry in the atomic world" by P. A. M. Dirac, "On the human value of scientific progress" by P. Auger, "Volcanic eruptions" by T. Watanabe, "Relation of science to democracy" by W. Kaempffert, "Hemoglobin" by Linus Pauling, "Scientific foundation of the planning in the U.S.S.R." by K. V. Ostrovityanov, "Study of India in the U.S.S.R." by A. A. Guber, "Scientific research in New China" by Chien Tuan-Sheng, "Science and its social relations" by A. R. Wadia. Some of the interesting special lectures were "Synthesis and stereochemistry of carotenoids" by Paul Karrer, "Metallogenetic provinces and epochs in Japan" by T. Watanabe, "Extensive showers of cosmic rays" by P. Auger, "Iron and manganese resources of Japan" by T. Watanabe, "Present state of geological education in Japan" by T. Watanabe, "Structure of proteins" by Linus Pauling, "Soda-ash industry" by T. P. Hou, "Chinese herbal medicines" by Hsieh Yu.

The meetings of the executive committee and the council of the Indian Science Congress Association were held on 3 January 1955. The meeting of the general committee was held on 8 January 1955. B. C. Roy was elected as general president for the year 1956–57. M. S. Krishnan, director, Geological Survey of India, is general president for the year 1955–56. The next session of the Science Congress will be held at Agra in 1956.

U. P. Basu, *General Secretary*
Indian Science Congress Association,
1 Park Street, Calcutta, India

Science News

Recently the Hoover Commission made public its recommendations on the **Federal medical services,** which it characterized as a cumbersome system that breeds inefficiency and huge waste. The commission's 16-member Medical Services Task Force noted that the services cost more than $2 billion annually exclusive of another $2 billion spent for disability allowances; that the Federal Government uses 10 percent of the nation's physicians, 9 percent of its dentists, and 6 percent of its nurses; and that the Federal Government operates 13 percent of the nation's hospital beds.

The fundamental recommendation in the report is the one that suggests the creation of a Federal Council of Health to further coordination, eliminate duplication, and develop over-all policies on Federal health services. In his letter transmitting the task force's report to former President Hoover, Theodore G. Klumpp, chairman, said:

> We place first in importance, among all of our recommendations, the creation of a Federal Council of Health. Without such a council, many of the remaining recommendations will fail of success; with it, they are almost sure of eventual, if not immediate, usefulness.

The proposed council would consist of members of the various branches of the medical profession and of eminent citizens who would serve by appointment of the President.

The Federal medical services have grown to include 26 Federal departments or agencies made up of 66 separate administrative units engaged in one or more health functions. Most of these groups have different objectives and responsibilities and serve different groups of the citizenry.

Recently Robert J. Havighurst, professor of education at the University of Chicago, told an American Council on Education subcommittee, which was established to study a Federal scholarship program, that each year approximately 100,000 qualified American high-school seniors have a strong **desire to go to college, but cannot afford it.** He said that annually approximately 300,000 graduates are in the top one-quarter of their classes, but never go on to higher education.

He placed these students in three categories of 100,000 students each: (i) those who have the necessary grades and a very strong desire to go to college, but not enough money; (ii) those who also have the

grades, and may or may not have the money, but who have only a weak motivation to continue their education after high school; and (iii) those who, although they may have both the money and desire, are felt to be unfit for college and in all probability would not be recommended by their high schools.

The complicated controversy over the **Arnold Arboretum of Harvard University** [*Science*, **119**, 369 (19 Mar. 1954); **119**, 459 (9 Apr. 1954)] has finally been resolved. The question involved a challenge of the Harvard Corporation's right, as administrators of the Arboretum trust, to plan the removal of the principal research collections of the library of the Herbarium of the Arnold Arboretum from Jamaica Plain to more accessible quarters in the new Harvard University Herbarium in Cambridge.

A decision on 11 Feb. by the Supreme Judicial Court of the Commonwealth of Massachusetts upheld the Attorney General's authority to determine a question involving the breach of a charitable trust. This action allows the Attorney General's decision of 2 July 1953 to stand. As described by the *Harvard Alumni Bulletin* of 26 Feb., the decision states that:

> . . . the judgment of trustees cannot be overridden by the courts unless the trustees decide arbitrarily, capriciously, or in bad faith; that the College reached its decision honestly, faithfully, and for what it considers to be the best interests of the Arboretum; that "there is no legal breach of trust;" and that under such circumstances to allow the question to come to court would "open the door to unreasonable and vexatious litigation."

William Penney, director of atomic weapons research for the British Atomic Energy Authority, has accepted an invitation to visit the United States to discuss a greater **exchange of nuclear information** and to observe the bomb tests that are taking place in Nevada. It has been suggested that this invitation reflects a belief here that Britain has developed processes for making hydrogen bombs that are more efficient and economical than this country's.

The McMahon Act of 1946, which forbids the exchange of atomic information even with friendly nations, was somewhat liberalized by Congress last August so that the way has been opened for the proposed discussion. However, Britain has no such restricting legislation and Penney is said to have the full authority of his government to make decisions.

The skull of Swanscombe man was discovered in Kent, England, in 1935 and 1936. Its assignment to the second interglacial period of the Pleistocene seems indisputable. The constituent bones, a parietal and an occipital, differ in no significant way from those of modern or sapiens man. It has been suggested, however, that the Swanscombe skull could have possessed a Neanderthaloid face such as occurs in the **Steinheim skull.** The latter, found in Germany in 1933, interestingly combines a Neanderthaloid face with a braincase that is rather more sapiens than Neanderthal in form. The Steinheim skull has generally been regarded as belonging to the third glacial or third interglacial period, and hence as younger than the Swanscombe skull. F. E. Zeuner, however, reports [*Man* **54**, 59 (Apr. 1954)] that a restudy by K. Adam of the gravels in which the Steinheim skull was found allocates them to the second interglacial period. Thus the Steinheim and Swanscombe skulls appear virtually contemporaneous. Zeuner insists that the question of the specific identity of these skulls must now be raised in earnest. In view of the known rather low degree of correlation between braincase and facial skeleton in Pleistocene man, it would of course be more than rash to assert that the Swanscombe skull represents true *Homo sapiens*. Contemporaneity notwithstanding, however, the burden of proof rests heavily on those who would hang a Steinheim or any other sort of Neanderthaloid face on the truly sapiens-like Swanscombe braincase fragments.—W.L.S., Jr.

On 2 Mar., for the first time since 1952, the Government revised and shortened its **lists of essential activities** and critical occupations—lists that are used, especially by the Department of Defense and local draft boards, as guides in official decisions regarding the equitable distribution of manpower between the armed services, defense production, and the civilian economy. The original lists included 25 essential activities and 62 critical occupations. The new lists name 10 of the former and 32 of the latter.

Two changes of particular significance are the segregation of research and development services into a separate category, and the addition to the occupations list of high-school science and mathematics teachers. For some of the scientific and professional fields, it should also be noted that the new lists apply only to those having graduate degrees, masters or doctors, or at least 1 yr of equivalent postgraduate training or experience.

The increase in **Japan's budget appropriations** for the promotion of science is shown by the following figures (in thousands of dollars); the two amounts given are for 1949 and 1954, respectively: government research institutes, $7513 and $16,847; national university research institutes, $1200 and $5452; research funds allotted to university chairs, $1690 and $6711; subsidies and research contracts, $1250 and $6730; travel expenses to international scientific conferences, 0 and 10; travel expenses for scientists and engineers, 0 and 23.

In February Henry Schmitz, president of the University of Washington, Seattle, would not approve the recommendation of the university's physics department that J. Robert Oppenheimer be invited to deliver a week of lectures during the spring term. He based his decision on Oppenheimer's "governmental relationships."

Recently both Victor Weisskopf of Massachusetts

Institute of Technology and Perry Miller of Harvard University have **refused invitations to lecture** at the University of Washington. Weisskopf has said that no "self-resepcting" physicist should go to the university after such a ban, and Miller termed the action "not only an egregious insult to a great scholar, but also a flagrant violation of the fundamental principles of intellectual integrity and liberty of spirit upon which the education system of a free society is erected."

William Creasy, a major general and the U.S. Army's chief chemical officer, reported recently that artificial smoke **reduces the effects of thermal radiation.** Preliminary tests conducted at the Nevada proving ground indicate that two types of smoke can be used: the fog-oil type, created by releasing hydrocarbon oil droplets into an artificial "smog" where they scatter and attenuate heat or light; and carbon smoke, which absorbs the heat radiation.

Many roads in Great Britain have been found to have been metalized by a **uranium-bearing slag** that is highly radioactive. A dispatch from London to *Foreign Trade,* an Ottawa publication, reports that as a result of the discovery, measures are being taken to discontinue the use of old-mine dumps in Devon and Cornwall as sources of road metal. A survey has shown that many of these tailings are good uranium ore.

Scientists in the News

Hans Suess, physical chemist for the U.S. Geological Survey, Washington, D.C., became a naturalized United States citizen on 8 Mar. He is a native of Austria, and during World War II he conducted research for the German atomic energy program. Suess has developed an acetylene gas counting method for radiocarbon dating [*Science* **120,** 5 (2 July 1954)]. This method, for which smaller samples than those necessary for either solid-carbon counting or scintillation counting can be used, has extended the possible range of radiocarbon dates from about 17,000 yr to about 33,000 yr. Suess has also published one list of radiocarbon dates in *Science* [**120,** 467 (24 Sept. 1954)]. He is coauthor, with M. Rubin, of a second list that will appear soon.

Commenting on the recent appointment of **Samuel Devons,** physicist, to the Langworthy chair of experimental physics at Manchester University (England), the *Manchester Guardian Weekly* for 3 Feb. reported on a few of the previous incumbents in a review of physics partially quoted here:

> . . . The last 70 years have seen a breathtaking transformation of physics and each Langworthy professor has played an important part in it. Balfour Stewart was the first holder; his textbooks on heat were standard works. Arthur Schuster followed him in 1887; he had worked with Clerk Maxwell. Physics was then just emerging as a separate science. Schuster's organization of the teaching of experimental physics set a pattern which became classical; his *Theory of Optics* was the standard textbook for years. Rutherford followed him in 1907, and, in his 12 years here, laid the foundation of our present understanding of atoms. His first act was to borrow a third of a gram of radium from Vienna and with this material a host of fundamental facts about radioactivity were discovered and Rutherford was able to formulate them in terms which are now accepted. He was awarded a Nobel prize in 1908. His successor, W. L. Bragg, was already a Nobel prize man. He devoted himself and his laboratory to an investigation of the structure of solids; he was a pioneer in the technique of x-ray diffraction. P. M. S. Blackett succeeded Bragg and his work in the field of cosmic rays is still fresh in the mind. In 1948 he, too, received the Nobel prize. A great professor of physics must be a man of many parts. He must be distinguished by his research or else he will not attract the right staff. He must be a teacher or he will not inspire his staff and students. He must have some of the talents of the business man or he will not effectively administer (or even acquire) the increasingly large sums needed to finance research projects. And he must have a feeling, too, for the life and balance of a university as a whole. . . .

John G. Bolton, who in 1948 discovered the first "radio stars," and who for the past 10 yr has served as a research officer in the division of radiophysics of the Commonwealth Scientific and Industrial Research Organization in Sydney, Australia, has been appointed a senior research fellow in physics and astronomy at California Institute of Technology. He will assume responsibility immediately as scientific director of a new project that will attempt to detect radio signals from outer space, find out what their sources are, and discover as much as possible about the position, strength, and size of these sources.

Elijah Adams, formerly of the Institute of Arthritis and Metabolic Diseases, Bethesda, Md., has been appointed associate professor of pharmacology at New York University College of Medicine.

President Ramon Magsaysay has awarded the following scientists the Distinguished Service Star for their outstanding contributions to Philippine science: **Joaquin Maranon, Nemesio B. Mendiola, Eduardo Quisumbing, Filemon C. Rodriguez, Alfredo C. Santos, Leopoldo P. Uichanco, Patrocinio Valenzuela, Deogracias Villadolid, Walfredo de Leon.**

George Ellis Armstrong, a major general and the surgeon general of the U.S. Army for the past 4 yr, has been named vice chancellor for medical affairs at New York University. His appointment as chief administrative officer of the New York University–Bellevue Medical Center is effective following his retirement from the Army in July. Armstrong has served with the Army for many years, having been an officer in the Medical Corps since his graduation

from Indiana University Medical School in 1925. Donal Sheehan, associate director of the Medical Center, has been acting director since the resignation of Edwin A. Salmon in March 1953.

Armstrong interned at Letterman General Hospital in San Francisco and has since served at many military posts in the United States and overseas. He is an honor graduate of the Army Medical School, Washington, D.C., a graduate of the basic and advanced courses of the Medical Field Service School, and a graduate of the Command and General Staff School.

Before World War II he was stationed at Schofield Barracks, Hawaii; Walter Reed Army Hospital, Washington, D.C.; Fort Benning, Ga.; Tientsin, China; Fort Stotsenberg, Philippine Islands; Carlisle Barracks, Pa.; and Camp Barkeley, Tex. During World War II he was assistant theater surgeon of the China-Burma-India theater in 1943–44, and for 2 yr was surgeon of the China theater. In 1946 he became chief of the personnel division of the surgeon general's office, and in 1947 he was appointed deputy surgeon general.

August W. Raspet, head of the department of aerophysics at Mississippi State College, is to deliver a lecture on "The sailplane in boundary layer research" before the Royal Institute of Technology in Stockholm, Sweden, on 5 Apr. He left on 21 Mar. in order to attend a conference on aviation research at the National Physical Laboratory, Teddington, England, and before he returns on 19 Apr. will go to Germany and France for conferences with leaders in aerodynamics research.

Avram Goldstein, assistant professor of pharmacology at Harvard University, has been appointed professor and executive head of the department of pharmacology and therapeutics at Stanford University School of Medicine, effective 1 July. He will fill the post left vacant by Windsor C. Cutting, who became dean of the Medical School in 1953.

Another new appointment at Stanford is that of **David M. Mason,** who is at present supervising research in chemical engineering at the jet propulsion laboratory of California Institute of Technology. He will become associate professor of chemical engineering on 1 Sept.

Andrey A. Potter, dean emeritus of Purdue University, will receive the annual award for outstanding service from the National Society of Professional Engineers when it meets 2–4 June in the Bellevue-Stratford Hotel in Philadelphia, Pa.

John F. Reinhard, former director of pharmacologic research in the Warner-Chilcott Research Laboratories, New York, has joined the Mead Johnson Research Laboratories, Evansville, Ind., as director of the pharmacology department. He succeeds **Marshall R. Warren,** who recently was promoted to director of the Pharmaceutical Research and Development Division.

Herbert E. Longenecker, a biochemist and dean of the Graduate School at the University of Pittsburgh, will become vice president of the University of Illinois in charge of the Chicago professional colleges. He will reach Chicago by 1 Aug. to fill the post held until July 1953 by Andrew C. Ivy. Longenecker will be administrative head of the university's colleges of medicine, dentistry, and pharmacy, graduate college in Chicago, school of nursing, research and educational hospitals, clinics, institutes, and other health science units at the West Side Medical Center.

Carroll Vincent Newsom, associate commissioner for higher and professional education of the State of New York and former professor and head of the department of mathematics at Oberlin College, will become executive vice chancellor of New York University on 15 July. He will fill the position to be vacated by **David Dodds Henry** when he assumes the presidency of the University of Illinois. Newsom is past president of the Southwest Division of the AAAS.

Erling Johansen, senior fellow in dental research at the University of Rochester School of Medicine and Dentistry, has been appointed chairman of the department of dentistry and dental research. He succeeds **John W. Hein,** who has been appointed dental director of the Colgate-Palmolive Co. Both appointments were effective on 1 Mar.

Martin Kamen, professor of biochemistry at Washington University, St. Louis, has been awarded $7500 damages by a District of Columbia jury, who agreed he had been libeled in 1951 by the *Washington Times-Herald*. The paper published a picture and two articles identifying him as the anonymous person described unfavorably by Sen. Hickenlooper (R. Ia.) in a Senate speech on 30 June 1951. A companion suit against the *Chicago Tribune,* which had printed the same material, was dismissed on a technicality; Kamen plans to appeal this ruling.

Olof Larsell, formerly professor of anatomy at the University of Oregon and at the University of Minnesota, is visiting professor of anatomy at the University of North Dakota School of Medicine for the current year.

Wilbur W. Hansen, former senior electrical engineer with Armour Research Foundation, has joined the staff of Stanford Research Institute, Stanford, Calif. He will work as a senior research engineer on the design of servomechanisms and controls for automation in the control systems laboratory of the engineering division.

The American Locomotive Co., Schenectady, N.Y., has announced several appointments to its atomic energy products department. One of the first projects that the new men will work on will be the construction of the Army package power reactor, for which the company was awarded a contract last December. The

APPR will be the Army's first nuclear-driven power plant and the first with components designed to be flown to remote bases in any part of the world.

J. L. Meem, Jr., for the past year a reactor physicist for the aircraft nuclear porpulsion project at the Oak Ridge National Laboratories, has been named chief reactor scientist.

Robert D. Robertson, formerly welding engineer with Air Products Corp., Emmaus, Pa., and Fitzgibbons Boiler Co., Oswego, N.Y., has been appointed materials engineer.

Harold Hoover, a project engineer who tested liquid metal components at the Knolls Atomic Power Laboratory, Schenectady, has become process design engineer.

Alice K. Bicknell, former chairman of the Wayne University bacteriology division, has been appointed chief of the bacteriology division at the New England Institute for Medical Research in Ridgefield, Conn.

R. Dana Russell, geophysicist and chairman of the Scientific Planning Board at the U.S. Navy Electronics Laboratory in San Diego, Calif., has accepted a position as head of geological research for the Ohio Oil Co. His principal office will be in Denver, Colo., where the company will construct a new laboratory. Before his departure from California, a commendation for meritorious service to the Navy was presented to Russell by Henry E. Bernstein, commanding officer of NEL.

James B. Lesh, a member of the staff of the Armour Laboratories, Kankakee, Ill., since 1939, has been appointed director of research. He succeeds **E. E. Hays,** who has resigned.

Webb Haymaker, chief of the neuropathology section of the Armed Forces Institute of Pathology, recently completed a 4-wk tour of the Federal Republic of Germany as a guest of the German Government. Haymaker's party was given an official welcome in Bonn, then held round-table conferences with appropriate Federal Ministries. The group of seven doctors, some of them leaders in the field of public health, also visited various German cities, including West Berlin.

The tour was part of an exchange program with the United States inaugurated in 1952. The objective is to give Americans an opportunity to become acquainted with present-day life and institutions in Germany, particularly in their fields of special interest.

Necrology

Charles H. Alvord, 82, retired agriculturist with the U.S. Department of Agriculture, Alexandria, Va., 20 Feb.; **Oswald T. Avery,** 77, bacteriologist, pneumococci investigator, emeritus member of the Rockefeller Institute for Medical Research, Nashville, Tenn., 20 Feb.; **Louis H. Baretz,** 59, former assistant professor of urology at the State University College of Medicine, Brooklyn, N.Y., 2 Mar.; **Allan P. Colburn,** 50, chemical engineer, provost of the University of Delaware, Newark, Del., 7 Feb.; **Frank J. Feely,** 63, retired engineer of manufacture for the Western Electric Co., Westfield, N.J., 22 Feb.; **Norman Gaskins,** 42, resin specialist, assistant professor of chemistry at Lincoln University, West Chester, Pa., 17 Feb.; **Calvin H. Goddard,** 63, medical historian, criminologist, developer of forensic ballistics, former asistant director of the Johns Hopkins Hospital and director of the Cornell Clinic, New York, 22 Feb.; **B. Britton Gottsberger,** 82, former instructor in mining and metallurgy at Yale University, New Haven, Conn., 28 Feb.

James C. Hening, 63, researcher and associate professor in the department of food science and technology at the State Agricultural Experiment Station, Geneva, N.Y., 17 Feb.; **Leon S. Johnston,** 67, author, professor of mathematics at the University of Detroit, Detroit, Mich., 18 Feb.; **Harold J. Kersten,** 56, investigator in roentgenology, author, professor of biophysics at the University of Cincinnati, Cincinnati, Ohio, 2 Mar.; **Wilhelmine E. Key,** 82, eugenist, former professor of biology at Lombard College, former eugenical field worker with the Carnegie Institution, Somers, Conn., 31 Jan.

Alwin M. Pappenheimer, 76, researcher on rickets, vitamin E deficiency, and viral diseases, professor emeritus of pathology at Columbia University, New York, 21 Feb.; **G. B. Reed,** 66, researcher on tuberculosis, gas gangrene, and rinderpest, retired head of the department of bacteriology, Faculty of Medicine, Queen's University, Kingston, Ont., Canada, 21 Feb.; **Victor C. Stechschulte,** 61, director of the Xavier University seismographical observatory and chairman of its mathematics-physics department, Cincinnati, Ohio, 3 Mar.; **Georg Tischler,** 77, dean of German plant cytologists, professor emeritus at the University of Kiel, Kiel, Germany, 6 Jan.

Meetings

The **Laurentian Hormone Conference of the AAAS** will hold its 1955 annual meeting at the Hotel Stanley, Estes Park, Colo., 11–16 Sept. Interested investigators and specialists in the hormone field may apply for attendance by writing to the Committee on Arrangements, 222 Maple Ave., Shrewsbury, Mass. Since accommodations at the hotel necessarily limit the number of participants, only those persons submitting applications can be considered. Completed forms must be received by the committee *no later than 6 May* in order to insure issuance of invitations a soon as possible thereafter. The program follows.

I. *Hormone Biosynthesis and Metabolism*: "The biosynthesis and metabolism of thyroid hormone," J. Roche, Collège de France; "The adrenal medulla and the formation of pressor amines," Paul Hagen and A. D. Welch, Yale University Medical School; "Biosynthesis of the sterols and steroid hormones, with particular reference to the estrogens," R. D. H. Heard, McGill University School of Medicine; "Biogensis of neutral steroid hormones," Mika Hayano, N. Saba, R. I. Dorfman, and O. Hechter, Worcester Founda-

tion for Experimental Biology; "Enzymatic mechanisms of steroid metabolism. (*a*) Oxidation-reduction reactions of the steroid nucleus. (*b*) Synthesis of steroid glucuronides," K. J. Isselbacher and G. Tomkins, National Institutes of Health.

II. *Hormones and Metabolism*: "Influence of steroids on cerebral metabolism in man," G. S. Gordan, University of California Medical Center; "Studies of aldosterone in relation to water and electrolyte balance," J. A. Luetscher, Jr., Stanford University School of Medicine; "Tissue metabolism and growth," M. E. Krahl, University of Chicago.

III. *Pituitary Hormones*: "Human urinary gonadotrophin," A. Albert, Mayo Clinic; "Hormonal control of melanin pigmentation," A. B. Lerner, University of Oregon Medical School; "Pituitary syndromes in man," R. F. Escamilla, San Francisco.

IV. "Male sex hormone and its role in reproduction," Thaddeus Mann, University of Cambridge, England; "Clinical studies of testicular hormone production," W. O. Maddock, C. A. Paulsen, and R. B. Leach, Wayne University College of Medicine; "The mechanism of progesterone effect on uterine muscle," A. Csapo, Carnegie Institution of Washington.

The 14th **National Organic Chemistry Symposium,** sponsored by the Division of Organic Chemistry of the American Chemical Society, is to be held in Lafayette, Ind., 13–16 June. Purdue University and the Purdue Section of the A.C.S. will act as hosts. The list of participants includes: Frederick L. Hovde, A. H. Blatt, Gilbert Stork, Stanley J. Cristol, Frank H. Westheimer, John D. Roberts, Arthur C. Cope, Nelson J. Leonard, Roger Adams, George S. Hammond, Melvin Calvin, John C. Bailar, Jr., E. J. Corey, William S. Johnson, and Vincent du Vigneaud.

The 16th general assembly of the **International Pharmaceutical Federation,** which is being organized by the Pharmaceutical Society of Great Britain, will be held in London, 19–23 Sept. For information, address the secretary of the federation's organizing committee, 17 Bloomsbury Sq., London, W.C. 1.

The **International Symposium on Modern Network Synthesis, II** forms a part of the celebration program commemorating the 100th anniversary of the Polytechnic Institute of Brooklyn. It will be held 13–15 Apr. at the Engineering Societies Building, 33 W. 39 St., New York, as the fifth in a series organized by the Microwave Research Institute of P.I.B.

The program will consider new advances in the synthesis of passive networks in the frequency and time-domains, including improved methods for designing RLC transducers and advances in the design of sampling filters. New developments in active and nonreciprocal circuits, such as recent unconventional applications of transistors, will also be presented. A round-table discussion is planned on the significance of new network-synthesis techniques to the solution of design problems in industry. Internationally known authorities will participate.

The cooperation of the Professional Group On Circuit Theory of the Institute of Radio Engineers and the cosponsorship of the Office of Naval Research, the Air Force Office of Scientific Research, and the Signal Corps permits this symposium to be held without admission charge or registration fee. The symposium proceedings will be published by October 1955; advance orders should be accompanied by a check for $5 made out to the Treasurer, Symposium Committee. For information, write Polytechnic Institue of Brooklyn, Microwave Research Institute, 55 Johnson Street, Brooklyn 1, N.Y.

The **Electrochemical Society** will hold its 107th meeting at the Sheraton-Gibson Hotel, Cincinnati, Ohio, 1–5 May. Sessions are scheduled on electric insulation; electronics, including luminescence, oxide cathodes, phosphor application, and semiconductors; electrothermics and metallurgy; industrial electrolytics; and theoretical electrochemistry. The program for the technical sessions lists 184 papers. Copies of the program booklet, which includes abstracts, will be available after 1 Apr. from the secretary, Henry B. Linford, Electrochemical Society, Inc., 216 W. 102 St., New York 25.

The 5th meeting of the **Congress of Nobel Prize Winners** will be held on 10–16 July in Lindau im Bodensee, Germany. For information write to the general secretary, Dr. F. K. Hein, Lindau, Germany. This is the second meeting of the prize winners in chemistry, and the program will include the following: Georg V. Hevesy, Stockholm; L. Ruzicka, Zurich; W. M. Stanley, Berkeley, Calif.; Artturi I. Virtanen, Helsinki; Harold C. Urey, Chicago; Richard Kuhn, Heidelberg; Robert Robinson, Oxford; H. Staudinger, Freiberg i. Br.; Hans v. Euler-Chelpin, Stockholm; Werner Heisenberg, Gottingen; Fritz Lipman, Boston. Acceptance by several others is expected.

The annual meeting of the **American Academy for Cerebral Palsy** is to be held in Memphis, Tenn., 10–12 Oct. The schedule will include instructional courses in the various phases of the disease as well as a formal program. The sessions are open to members of the medical and allied professions who are interested in cerebral palsy. Those wishing to attend may obtain an invitation from the secretary-treasurer, Robert A. Knight, 869 Madison Ave., Memphis 3, Tenn. Hotel reservations are to be made directly with Mr. Scott Stewart, Claridge Hotel, Memphis.

The annual summer conference sponsored by the biology department of the **Brookhaven National Laboratory,** Upton, N.Y., will take place 15–17 June. Those planning to attend should notify R. C. King of the laboratory's biology department *by 21 May.* Noncitizens of the United States should indicate nationality.

The program, which will be concerned with mutation, includes the following speakers and topics: S. Benzer, genetic fine structure and its relation to the DNA molecule; A. D. Hershey, chemical organi-

zation of virus genetic material; J. G. Gall, ultrastructure of chromosomes; A. W. Ravin, properties of bacterial transforming systems; G. Bertani, role of phage in bacterial heredity; Barbara McClintock, intranuclear systems controlling gene action and mutation; M. Demerec and Zlata Demerec, factors determining the effectiveness of certain mutagens; H. B. Newcombe, timing of the induced mutation process in *Streptomyces* spores; N. H. Giles, Jr., forward and back mutation at specific loci in *Neurospora*; H. J. Muller, relation between chromosome changes and gene mutation; J. S. Kirby-Smith, effects on the genetic material due to radiations of different linear energy transfer; H. B. Glass, properties of genetic material manifested by changed mutability during different stages of gametogenesis; W. L. Russell, mutational characteristics of specific loci; W. S. Stone, indirect effects of radiation on genetic material; W. K. Baker, oxygen effect and the mutation process; and A. Novick, mutagens and antimutagens. K. G. Stern, R. D. Hotchkiss, W. R. Singleton, A. Srb, A. H. Sparrow, and K. Sax are chairmen. The symposium committee consists of R. C. King, V. W. Woodward, A. H. Sparrow, Marian E. Koshland, and H. J. Curtis.

The location of the 3rd **International Congress of Vitamin E** [*Science* **121**, 159 (4 Feb. 1955)] has been changed from Milan to Venice, and the dates have been specifically designated as 4–7 Sept. Karl E. Mason, professor of anatomy at The University of Rochester School of Medicine and Dentistry, has been appointed American representative to the congress.

Society Elections

Society of Economic Paleontologists and Mineralogists: pres., F. J. Pettijohn, Johns Hopkins University; v. pres., Robert R. Shrock, Massachusetts Institute of Technology; sec.-treas., Samuel P. Ellison, Jr., University of Texas.

Interamerican Society of Psychology: pres., Willard C. Olson; v. pres., Guillermo Davila; sec.-gen., Werner Wolff; treas., Gustave M. Gilbert.

American Statistical Association: pres., Seymour L. Wolfbein, U.S. Bureau of Labor Statistics; pres.-elect., Felix Moore, National Institutes of Health; v. pres., Gladys Palmer, University of Pennsylvania and P. M. Hauser, University of Chicago; sec., A. J. Jaffe, Columbia University.

Mathematical Association of America: pres., W. L. Duren, Jr., Tulane University; 1st v. pres., H. S. M. Coxeter, University of Toronto; 2nd v. pres., G. B. Price, University of Kansas; sec.-treas., H. M. Gehman, University of Buffalo.

Florida Academy of Sciences: pres., Joseph C. Moore, Everglades National Park; pres. elect, H. K. Wallace, University of Florida; sec.-treas., R. A. Edwards, University of Florida.

Society of American Bacteriologists: pres., H. O. Halvorson; v. pres., Charles A. Stuart; sec.-treas., John Hays Bailey.

Institute of Radio Engineers, Inc.: sec., Haraden Pratt; treas., W. R. G. Baker, General Electric Co.; editor, John R. Pierce, Bell Telephone Laboratories.

American Mathematical Society: pres., R. L. Wilder, University of Michigan; v. pres., Emil Artin, Princeton University; sec., E. G. Begle, Yale University.

Western Society of Naturalists: pres., Lyman Benson; v. pres., Albert Tyler, California Institute of Technology; sec., Demorest Davenport, Santa Barbara College, University of California; treas., Ivan Pratt, Oregon State College.

National Society for Medical Research: honorary pres., Anton J. Carlson, University of Chicago; pres., Lester J. Dragstedt, University of Chicago; v. pres., Maurice Visscher, University of Minnesota; sec.-treas., Ralph Gerard, Illinois Neuropsychiatric Institute.

Education

A new examination, **Physical Chemistry Form L**, is featured in the national college testing program of the Examinations Committee of the American Chemical Society's division of Chemical Education. Form L has been assembled from items submitted and criticized by about 60 collaborators. The selection of questions included is based upon pretesting under classroom conditions in more than 30 institutions and upon an analysis of the difficulty and reliability of each question. To obtain more extensive coverage of theoretical concepts, questions dealing specifically with laboratory manipulation have been omitted. This examination covers topics customarily treated in the year's course in physical chemistry. In addition, the General Chemistry Form K has been reprinted.

These two tests are part of the spring testing program sponsored by the Examinations Committee. The program also includes tests in qualitative analysis, quantitative analysis, organic chemistry, and biochemistry. More than 48,000 students in 550 colleges and universities in the United States and several foreign countries were tested under this program last year. Further information and copies of the tests may be obtained from Dr. Theo. A. Ashford, St. Louis University, St. Louis 4, Mo. Limited copies of older examinations are available in addition to the tests featured in the testing program.

In February a branch of **Human Relations Area Files, Inc.**, was opened at **American University**, Washington, D.C. Donald H. Hunt, for 4 yr chief of the social relations section of the Library of Congress, is director. The presidents of seven neighboring universities were invited to participate in an inauguration ceremony for the new center, which is a unit of an inter-university research project that was established

at Yale University in 1949 and which is now sponsored by 16 universities extending from New England to Hawaii.

The organization's objective is to simplify the problem of finding out why human beings behave the way they do. The research cuts across the various branches of the social sciences, and factual data is organized and filed at each of the member universities. A system is used by which entire books are annotated according to subject, reproduced by a new electrical device, and the reproduced pages are then filed according to a numerical filing system. It takes only a moment to pick out a sheaf of 150 notes on a subject.

Yale University will begin next fall a new 2-yr **program in medical sociology** that is designed for Ph.D. candidates in sociology who have completed 2 yr of graduate study. The object of the course is to train students to apply the knowledge and techniques of sociology to the fields of medicine and public health.

A grant of $58,000 from the Commonwealth Fund will support the program itself, and a $9000 grant from the Russell Sage Foundation is to support a study unit in medicine and sociology that will guide the new program. In addition, Yale will provide some tuition scholarships.

An intensive 2-wk course for engineers in industry who have had no experience in nuclear technology will be offered by the University of Michigan this summer. Called **"Nuclear Reactors and Radiations in Industry,"** the course will run 15–26 Aug. The tuition fee of $200 will cover the cost of a complete set of printed course notes.

The Institutum Divi Thomae has announced a special summer seminar in **science and philosophy** to be held from 27 June through 29 July. Morning sessions will be devoted to an intensive series of lectures on adsorption and chromatography by H. G. Cassidy of Yale University, and in the afternoon there will be discussion of problems in the philosophy of science by members of the Albertus Magnus Lyceum. The subjects scheduled are "Logic and methodology in modern science," John T. Bonee; "Foundational physics," William H. Kane; and "Concepts and structure of the specialized sciences," Augustine Wallace. The series is planned primarily for teachers in liberal arts colleges, but is open to others. The cost will be $60, exclusive of living expenses A limited number of tuition scholarships is available. Inquiries should be addressed to the Dean, Institutum Divi Thomae, 1842 Madison Rd., Cincinnati 6, Ohio.

In order to combat the apathetic attitude to religion developed by students as they study science, the Danforth Foundation will sponsor for the third year a seminar workshop on the **Teaching of the Natural Sciences in Relation to Religious Concepts.** The sessions will take place 10–23 July at Pennsylvania State University. College science teachers will consider problems incident to the teaching of the natural sciences in relation to religious concepts. It is felt that the need that teachers concern themselves with religious interpretations of reality and of all human experiences has grown progressively greater, and that this need is present for all faiths and in all disciplines and instructional areas.

William G. Pollard, physicist and executive director of the Oak Ridge Institute for Nuclear Studies and an ordained member of the Christian ministry, again will be one of the seminar leaders and lecturers. His morning lectures and discussions will deal with "Scientific and religious categories of thought" and his evening series with "The Judeo-Christian tradition."

A lecture and discussion on "Educational issues and teaching problems—strategy and tactics" will feature the second part of each morning's session. Harold K. Schilling, professor of physics and dean of the Graduate School of Pennsylvania State University, will deal with these matters and will consider both curricular and extracurricular aspects of teaching.

The director of the seminar will be W. Conrad Fernelius, professor and head of the department of chemistry at Pennsylvania State. The cost of the conference, including meals and lodging, will be $95; Danforth scholarships in this amount will be available for 25 qualified registrants who *apply before 1 May.* A minimum of 3 yr of experience in teaching college courses in the natural sciences or mathematics is required for admission. It is hoped especially that younger staff members will attend. Registrants who are eligible and who meet certain requirements may earn two semester hours of graduate credit. Complete information is available from Dr. W. Conrad Fernelius, Pennsylvania State University, State College, Pa.

The Oak Ridge Institute of Nuclear Studies will present a summer institute for **secondary school science teachers** in Oak Ridge, 1–26 Aug. This program will be sponsored by the National Science Foundation and will be conducted by the ORINS Special Training Division. The institute is intended to provide to a selected group of approximately 48 teachers in the physical sciences an up-to-date review of scientific developments, emphasizing that science should be taught and learned as a whole rather than as a series of highly specialized and unrelated technologies.

Financial assistance up to $215 will be granted to a number of selected participants. *Deadline for return of application blanks is 15 Apr.* Information may be obtained from Ralph T. Overman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.

A department of metallurgical engineering has been established in the **New York University College of Engineering** under the acting chairmanship of John P. Nielsen. This brings to 12 the number of departments in the college. The last new one, the department of meteorology and oceanography, was created in 1937. Facilities of the new department include a completely equipped metallurgical research laboratory

and a smaller undergraduate laboratory. Heretofore, metallurgical work has been carried out in the department of chemical engineering and in the college's research division.

The 1955 **Summer Institute for Teachers of Mathematics** will be held at the University of Oklahoma, 6–17 June. Cost of participation is $15 for 1 wk or $25 for 2 wk. Interested teachers should communicate immediately with F. Lee Hayden, Short Courses and Conferences, University of Oklahoma, Norman.

Available Fellowships and Awards

With the aid of a grant from the Hewlett-Packard Co., Palo Alto, Calif., Stanford University has recently established a graduate fellowship in **medical electronics**. This fellowship is open to a man with a major interest in electronics coupled with an interest in medicine or biology. Such a man will normally have a bachelor's degree in electrical engineering or physics.

The fellowship will carry an annual stipend of $1800 to $2500, depending upon the qualifications of the candidate. Candidates should make application to the Assistantship and Fellowship Committee of the Electrical Engineering Department at Stanford *before 1 Apr.*

Research proposals directed to the Division of Biological and Medical Sciences of the **National Science Foundation** will be received at any time. The proposals on research projects to begin during the latter half of the academic year 1955–56 will be reviewed during October 1955. These proposals should be received by the foundation *before 15 Sept.*

A trust agreement establishing the Ruth Newman Van Horn Foundation has been completed recently by F. R. Newman of Cleveland, Ohio, providing an annual special **fellowship in urology** at Memorial Center for Cancer and Allied Diseases, 444 E. 68 St., New York 21. The fellowship approximates $3600 per year, and appointments will be made by the Memorial Board of Managers on recommendation of the chief of Urology Services.

Grants and Fellowships Awarded

The **John and Mary R. Markle Foundation** has announced that 22 faculty members of medical schools in the United States and Canada have been appointed scholars in medical science, in continuance of a program begun in 1948 to aid doctors planning careers in academic medicine. The foundation has appropriated $660,000 toward support of these men and their research, to be granted over a 5-yr period at the rate of $6000 annually, to each of the 22 medical schools where the men will teach and conduct their investigations. The scholars were selected from 52 candidates nominated by medical school deans.

Medical College of Virginia, Richmond. E. L. Becker. Internal medicine and renal physiology.

University of Pennsylvania. L. W. Bluemle, Jr. Internal medicine.

Washington University, St. Louis, Mo. H. R. Butcher, Jr. General surgery.

Johns Hopkins University. L. E. Cluff. Internal medicine and infectious diseases.

University of Cincinnati. J. J. Cohen. Physiology and internal medicine.

University of Manitoba, Winnipeg, Man. T. W. Fyles. Internal medicine, physiology, and bacteriology.

Laval University, Quebec, Que. P. M. Gagnon. Anatomy.

University of Washington, Seattle. N. B. Groman. Bacteriology, parasitology, virology.

Western Reserve University. J. W. Harris. Laboratory and physical diagnosis; advanced hematology; internal medicine.

Bowman Gray School of Medicine of Wake Forest College, Winston-Salem, N.C. A. Hinman. Growth and development; clinical pediatrics.

Columbia University College of Physicians and Surgeons. F. G. Hofmann. Pharmacology, physiology, and histology.

Yale University. E. H. Hon. Obstetrics, gynecology, and gynecologic endocrinology.

University of Saskatchewan, Saskatoon. R. B. Lynn. Surgery; intracardiac surgery.

Duke University. W. S. Lynn, Jr. Clinical medicine and biochemistry.

University of Kansas School of Medicine, Lawrence. C. A. Miller. Pediatrics and microbiology.

University of Utah. G. T. Perkoff. Metabolic diseases, physical diagnosis, and clinical pathology.

University of Wisconsin. G. G. Rowe. Medicine (cardiology) and anatomy.

Marquette University. R. H. Segnitz. Pediatric and general surgery.

Medical College of South Carolina. C. McC. Smythe. Medicine and clinical physiology.

University of Chicago. D. W. Talmage. Immunology and allergy.

Baylor University College of Medicine, Houston, Tex. H. Tivey. Medical statistics; medical physics and isotope techniques.

Emory University. H. L. Williams. Pharmacology and physiology.

Eli Lilly and Co. has announced these research grants.

Brigham Young University. H. S. Broadbent, chemistry. Hydroquinoxalines.

University of British Columbia. J. G. Foulks, pharmacology. Research program in dept. of pharmacology.

University of Chicago. M. E. Krahl, physiology. Renewal grant, 1 yr, research on insulin and related subjects.

State University of New York College of Medicine. J. S. Robb, pharmacology. Effect of drugs—in particular, Paveril Phosphate (Dioxyline Phosphate, Lilly) and Papaverine—on the perfused mammalian heart.

University of Pennsylvania School of Medicine. E. D. DeLamater, dermatology and microbiology. Cytochemical, cytological, and cytogenetic studies on the site of action of the antibiotics and other drugs in bacteria and other cells.

North Texas State College. J. J. Spurlock, chemistry. Barbituric acids.

University of Utah College of Medicine. L. S. Goodman, pharmacology. Anticonvulsant drugs.

Veterans Administration Hospital, New Orleans. P. Pizzolato. *Malleomyces pseudomallei.*

Western Research University School of Medicine. (I) A. C. Barnes and R. A. Hingson. Evaluation of oxytocics with relation to effectiveness and incidence of side-effects, especially changes in blood pressure. (II) W. F. H. M. Mommaerts, biochemistry. Insulin. (III) H. G. Wood, biochemistry. Biosynthesis of nucleotides.

University of California School of Medicine. I. L. Chaikoff. Diabetes and insulin.

Cerebral Palsy Clinic, Dallas. W. H. Bradford. Drugs in cerebral palsy.

University of Chicago. D. J. Ingle, biological sciences. Mechanisms of hormone action on growth and metabolism.

Louisiana State University School of Medicine. G. J. Buddingh, microbiology. Research in the dept. of microbiology.

University of Michigan. Fellowship for dept. of chemistry.

Mount Sinai Hospital, New York. D. A. Dreiling, chemistry. To assist in publishing a monograph on the external pancreatic secretion of man.

National Science Teachers Association, Washington, D.C. To support development of the Future Scientists of America Foundation.

University of Oklahoma School of Medicine and University Hospitals. T. H. Haight. Problems of antibiotic therapy and research in infectious diseases.

Hospital of the University of Pennsylvania. J. E. Eckenhoff, anesthesiology. Work in the dept. of anesthesiology.

Purdue University. C. L. Porter, biological sciences. New sources of antibiotics.

Rockland State Hospital, Orangeburg, N.Y. N. S. Kline. Adrenocortical response to insulin.

University of Washington. R. H. Williams. Insulin and diabetes.

January and February research allocations by the **Damon Runyon Memorial Fund** are as follows:

Sloan-Kettering Institute, New York. Cancer research bed, $1185.

Medical College of Virginia. J. H. Salley. Oral neoplasia, $7000.

Vincent Memorial Hospital, Boston. J. B. Graham. Cancer immunity, $15,000.

Tufts College Medical School. W. H. Fishman, $8000.

State University of New York College of Medicine. I. Koprowska, $9000.

George Washington University, Washington, D.C. I. Cornman, $5500.

Wills Eye Hospital, Philadelphia. A. W. Vogel. Renewal for experimental fundal tumors of the eye, $6500.

A. P. Cooke Memorial Cancer Laboratory, Florida Southern College, Lakeland. B. Sokoloff, $2800.

Immaculata College, Immaculata, Pa. S.M. St. Agatha Suter. Supplementary grant, $540.

Institut Jules Bordet, Brussels, Belgium. H. J. Tagnon. Cancer research, $9700.

Connemaugh Valley Memorial Hospital, Johnstown, Pa. To expand its cancer program with particular reference to lung cancer, $7500.

Good Samaritan Hospital, Palm Beach, Fla. Cancer research beds, $5000.

St. Mary's Hospital, Palm Beach, Fla. Cancer research beds, $5000.

Columbia University, College of Physicians and Surgeons. G. C. Godman, $6500.

University of Rochester. S. Tarbell, $7500.

Washington University. C. E. Rubin, $8500.

University of Wisconsin. J. M. Price. Amino acid metabolism in patients with neoplastic cachexia, $5800.

National Academy of Sciences, National Research Council, Washington, D.C. To support U.S.A. National Committee on the International Union Against Cancer, $100.

Fellowships

O. Miro-Quesada, Sloan-Kettering Institute, $5400.

W. B. Summers, Veterans Hospital and Research Laboratory, Denver, Colo., $4800.

B. Bjorklund, Columbia University College of Physicians and Surgeons, $3000.

E. J. Mason, Western Reserve University, Cleveland.

P. S. Moorhead, University of Texas, Galveston.

The **National Council to Combat Blindness** approved the following grants-in-aid and fellowship awards for 1954–55:

Retina Foundation, Boston. E. A. Balazs. Synthesis of hyaluronic acid in the vitreous body of embryos and young animals, $4000.

University Hospitals, State University of Iowa. H. M. Burian. Temporal relationships of electric responses and chronaxie of human retina (continuation), $2000.

Ohio State University College of Veterinary Medicine. C. R. Cole. Ocular taxoplasmosis in domestic animals, $2000.

University of Buffalo Medical School. A. N. Dellaporta. Pathological studies on experimental retinal detachment, $2000.

Ohio State University, Department of Optometry. V. J. Ellerbrock. Compilation of a volume on research in subnormal vision, including evaluation of all aids, $960.

Presbyterian Hospital Medical Center, Institute of Ophthalmology, New York. W. G. Everett. Mensuration of the human eye by x-ray and the relationship of measurements to pathological states (renewal), $250.

New York Eye and Ear Infirmary. B. Goldberg, R. Levene, G. Kara. Possible role of hyperestrinism in the pathogenesis of retrolental fibroplasia (renewal), $1000.

Wills Eye Hospital, Philadelphia. H. Green, I. H. Leopold. Lens metabolism and cataract formation (renewal), $3000.

New York Eye and Ear Infirmary. J. H. Jacobson. Electroretinography in retinal diseases, $2400.

University of California Medical Center, San Francisco. S. J. Kimura. Study of keratitis sicca and Sjogren's syndrome, $1200.

University Hospitals, State University of Iowa. P. J. Leinfelder. Effect of change in pH in the equeous humor on metabolism of the lens and cornea, $1500.

Government Hospital, Haifa, Israel. I. C. Michaelson. New vessel growth in the eye, particularly in the retina and cornea (renewal), $2800.

Kumamoto University Medical School, Japan. Y. Mitsui. Cultivation of trachoma virus in cultivated human conjunctival epithelium by roller tube, $2650.

Ziya Gun Institute for Research in Trachoma, University of Istanbul, Turkey. F. N. Sezer. Cultivation of trachoma virus (renewal), $2000.

Institute of Ophthalmology, Columbia University. G. K. Smelzer. Investigation of experimentally produced exophthalmos, $1200.

Royal College of Surgeons and the Royal Eye Hospital, London. A. Sorsby. Biochemistry of hereditary retinal lesions, $3000.

Manhatten Eye, Ear and Throat Hospital, New York. C. C. Teng. Optic nerve study, $2500.

College of Physicians and Surgeons, Columbia University. L. von Sallman. Clinical and experimental studies in the distribution of P^{32} in tumors of the eye, $1000.

Albert Einstein Medical Center, Philadelphia. C. Weiss. Exhibit of laboratory aids in the diagnosis of infections of the eye (bacteriologic, serologic, mycologic, virologic, and parasitologic procedures) at the International Congress of Clinical Pathologists, Washington, D.C., 6–11 Sept. 1954, $200.

Eye and Ear Hospital, University of Pittsburgh Medical Center. J. J. Wolken. Photoreceptor structure, $3000.

The **U.S. Atomic Energy Commission** has announced the award of 27 unclassified physical research contracts.

Kentucky Research Foundation. B. D. Kern. Study of nuclear energy levels, $28,705.

University of Utah. I. B. Cutler. Recrystallization and sintering of oxides, $7400.

University of Virginia. A. T. Gwathmey. The growth and chemical properties of nearly perfect crystals, $14,424.

California Institute of Technology. J. W. DuMond. Precision nuclear spectroscopy, $84,428.

California Institute of Technology. H. Brown. Study of the fundamental geochemistry of critical materials and the development of economic processes for their isolation, $138,240.

University of California. C. S. Garner. Isotopic exchange reactions, $19,599.

University of Illinois. P. A. Beck. Annealing of cold worked metals, $21,100.

Johns Hopkins University. G. N. Delke. Absorption and fluorescent spectra of solid uranium compounds, $37,100.

University of Michigan. W. C. Parkinson. 42-in. cyclotron program, $83,120.

University of Michigan. H. R. Crane. Nuclear research with 300 Mev synchrotron, $79,180.

University of New Hampshire. H. M. Haendler. Infrared spectroscopy of inorganic fluorides, $11,010.

University of Tennessee. H. A. Smith. Catalytic reactions involving deuterium and vapor pressure studies of H_2O-D_2O mixtures, $1988.

Vanderbilt University. E. A. Jones. Raman spectra of some inorganic fluorine compounds, $6983.

University of Illinois. T. A. Read. Diffusionless phase changes in nonferrous metals and alloys, $29,222.

University of Illinois. E. A. Alperovitch. Occurrence of technetium in nature, $18,117.

Kansas State College. R. E. Hein. Labeled chemical species produced by neutron irradiation of phosphorus trichloride and related compounds, $5980.

University of California. R. L. Scott. Research on fluorocarbons solutions, $13,000.

Columbia University. C. H. Townes. Microwave spectroscopy, $21,000.

University of Connecticut. R. Ward. Tracer element distribution between a solid and a melt, $7000.

Purdue Research Foundation. K. Lark-Horovitz. Linear electron accelerator for nuclear physics, $4000.

Pennsylvania State University. W. W. Miller. Chemical reactions induced in condensed systems by beta decay, $7995.

Purdue Research Foundation. R. M. Whaley. Basic research

clear reactions with fast alpha particles, neutrons, and deuterons and a study of nuclear structure, $50,000.

Purdue Research Foundation. R. M. Whaley. Basic research using high-energy electrons and x-rays produced by a 300 Mev synchrotron, $94,240.

University of Rochester. E. O. Wiig. Radiochemistry, $14,545.

University of Tennessee. P. B. Stockdale. Investigation of the Chattanooga black shale of Tennessee as a source of uranium, $22,895.

Vanderbilt University. M. D. Peterson. Radiation stability and inorganic radiochemistry, $27,034.

Yale University. W. W. Watson. Isotope separation by thermal diffusion and nuclear studies with separated isotopes, $11,000.

The following **AAAS research grants** have been awarded:

New Hampshire Academy of Science to Paul R. Doe, Spaulding High School, Rochester. Preparation of 4,4-disubstituted piperidines by means of the Guareschi reaction and reduction with lithium aluminum hydride.

Indiana Academy of Science to John S. Karling, Purdue University. The fungus genus *Synchytrium* in Indiana, Illinois, and eastern Wisconsin.

Ohio Academy of Science to Committee on "Ohio Flora."

Ohio Academy of Science to Harold Gray Multer, Ohio State University. Geology of Wayne County, Ohio.

The **National Foundation for Infantile Paralysis** has announced the following grants to 12 regional respirator centers. A 13th center, newly opened in New York, already has received its grant for the fiscal year.

Mary MacArthur Memorial Respirator Unit, Wellesley Hills, Mass., $62,956.

Poliomyelitis Respiratory Center, University of Illinois, Research and Educational Hospitals, Chicago, $83,664.

Jack Martin Polio Respirator Center of Mt. Sinai Hospital, New York, $66,296.

Poliomyelitis Respiratory Center, Fairmount Hospital, San Leandro, Calif., $67,151.

Respiratory Center, University of Buffalo Chronic Disease Research Institute, Buffalo, N.Y., $60,205.

Southwestern Poliomyelitis Respiratory Center, Houston, Tex., $206,332.

Poliomyelitis Respiratory Center, Vanderbilt Hospital, Nashville, Tenn., $21,634.

Poliomyelitis Respiratory Center, Creighton Memorial-St. Joseph's Hospital, Omaha, Neb., $30,429.

Northwest Poliomyelitis Respiratory Center, King County Hospital (Harborview), Seattle, Wash., $25,395.

University of Michigan Poliomyelitis Respiratory Center, Ann Arbor, $36,416.

Rancho Los Amigos Respiratory Center for Poliomyelitis, Hondo, Calif., $77,373.

In the Laboratories

ElectroData Corp., an affiliate of Consolidated Engineering Corp., has announced plans for the construction of a new $750,000, 40,000-ft² plant in Pasadena, Calif., that is expected to be completed by August. An unusual feature of the new facility will be a demonstration computing center that is to be housed within glass walls and visible from the main lobby area, making it possible for visitors and potential users of the company's Datatron to observe a complete high-speed electronic data-processing system in operation.

General Electric has inaugurated a four-way communication system for the rapid processing of engineering and research problems on two electronic calculators. Linked in the system are G.E. plants in Evendale, Ohio, where the computing center of the Aircraft Gas Turbine Division is using an IBM 701 on three shifts daily; the Medium Steam Turbine, Generator and Gear Department at Lynn, Mass., and the Large Steam Turbine-Generator Department at Schenectady, N.Y. Fourth point in the network is International Business Machines' Technical Computing Bureau in New York where G.E. is renting a second 701 for a full 8-hr shift daily. The link between the computing centers in this system is provided by I.B.M.'s recently announced Electronic Data Transceiver, a device that duplicates sets of punched cards at remote points by means of telephone, telegraph, or radio circuits. The transceiver arrangement augments a network of telegraphic equipment that G.E. has been using to deliver its problems and answers from turbine departments at Schenectady and Lynn to the computing facility in Evendale. The introduction of the transceiver into this type of operation will increase speed and at the same time will increase reliability in transmission. When telephone circuits are used, as will be the case in the early stages of the present hookup, cards are reproduced from point to point at the rate of 11 fully punched cards a minute.

W. A. Taylor and Co., Baltimore manufacturer of colorimetric control equipment, is observing its 25th anniversary of operation in 1955. The group of Taylor colorimetric comparators now includes instruments for determining *p*H, chlorine, bromine, and phosphate as well as complete sets for analysis of boiler, municipal, industrial, and swimming-pool water and for control of chemical processes. When the company first began business, only two types of comparators were made, one for general *p*H control and the other for chlorine control. Principals in the company are W. A. Taylor and G. E. Miller. F. R. McCrumb is in charge of development work and J. A. Lambrecht is serving as general manager.

Completion of the **Westinghouse Electric Corp.'s** 5-yr, $32-millon expansion program at its Steam Division, South Philadelphia, Pa., has more than doubled the division's productive capacity for steam turbines and associated equipment. In addition to the division's expanded manufacturing and testing facilities, a new $6-million steam- and gas-turbine research and development laboratory has been completed. The entire expansion program involved reoccupancy, under lease agreement, of the Navy-owned Merchant Marine plant adjoining the South Philadelphia works, extensions to existing buildings, and extensive purchases of new machine tools as well as the new development laboratory.

The development laboratory has been functionally designed so that it divides into several individual laboratories and special facilities. It consists of eight principal components: machinery test hall for testing steam- and gas-turbine plants and components; closed-circuit wind tunnel powered by a 9000-hp steam turbine for axial-flow compressor development; aerodynamics laboratory for investigating turbine and compressor blading and other special air- and steam-flow

problems; combustion laboratory for gas-turbine combustion and corrosion study; heat exchange and hydraulics laboratory; mechanical laboratory for vibration, control, mechanical, and lubrication studies; machine, woodworking, fabricating, and model shop; high-pressure and high-temperature boiler, supply line, and reheater. A key part of the new laboratory is the instrument room, which contains more than $300,000 worth of indicating, recording, and calibrating instruments.

Stauffer Chemical Co., New York, has completed a modern insecticide and fungicide blending plant at Lubbock, Tex. To assure rapid delivery of insecticide and fungicide formulations as required by local crop and pest conditions, the Lubbock plant now replaces Stauffer warehouse facilities established 3 yr ago in the same area.

The selection of a plant site near Antioch, Calif., for the manufacture of tetraethyl lead—antiknock additive for gasoline—and Freon refrigerants, has been announced by the **Du Pont Co.,** Wilmington, Del.

Instruments and Materials

Surface tension of liquids over a wide temperature range can be measured with a new Cassel type **surface tensiometer.** Minimum sample requirement is 0.02 ml. The instrument measures the maximum pressure attainable inside a small bubble that is formed over an orifice in such a manner that corrections for hydrostatic head are negligible. The components of the instrument are the orifice, a piston for applying gas pressure inside the bubble, and a manometer. The sample and orifice are situated inside a thermal jacket near a thermometer. Different sizes of orifices are available. (National Instrument Laboratories, Inc., Dept. Sc., 6108 Rhode Island Ave., Riverdale, Md.)

The Dyson **interferometer microscope,** which is manufactured by Cooke Troughton and Simms, Ltd., has been offered for general sale. It is reported that this instrument is especially useful as a quantitative tool for the measurement of dry mass, that it provides a continuously variable system of phase-contrast observation, that it provides either a color- or an intensity-contrast image, and that it eliminates the halo typical of conventional phase-contrast microscopes. (R. Y. Ferner Co., Inc., Dept. Sc., 110 Pleasant St., Malden 48, Mass.)

A new brochure describing the MF **Millipore filter** and its uses, including references to the literature, has been released. This membranous filter, which is made of cellulose-based chemicals, is available in sheet form. The material contains approximately 80 percent voids arranged in a uniform cell structure of about 50 million pores per square centimeter. It is about 150 μ thick and is available in two types, hydrosol assay with a pore size of 0.45 μ, and aerosol assay with a pore size of 0.8 μ. (Millipore Filter Corp., Dept. Sc., Watertown 72, Mass.)

Machlett has announced a new 45,000 rev/min **homogenizer,** the VirTis 45, that is useful for both micro and macro work. The instrument handles volumes from 0.2 to 200 ml through the use of four fluted homogenizing flasks. An aerosol free assembly that prevents aerosols from escaping and protects the substance being homogenized from outside impurities fits the top of the flask. The design of the top drive assembly is intended to eliminate heat formation and leakage. Speed of the 1/5-hp motor can be varied from 100 to 45,000 rev/min by means of a built-in variable transformer. (E. Machlett and Son, Dept. Sc., 220 E. 23 St., New York 10.)

New Journals Received

Antibiotic Medicine, vol. 1, No. 2, Feb. 1955, Journal of clinical studies and practice of antibiotic therapy. Henry Welch, Ed. Md Publications, 30 East 60th St., New York 22. $15 per year.

The ASB Bulletin, vol. 1, No. 3, Sept. 1954. Victor A. Greulach, Ed. Association of Southeastern Biologists, Chapel Hill, N.C. (Order from J. Paul Reynolds, Dept. of Zoology, Florida State University, Tallahassee). Quarterly. $2 per year.

Astronautics, vol. 1, No. 1, Fall 1954. Martin Caidin, Ed. American Astronautical Society, 516 Fifth Ave., New York 36. Quarterly. $6 per year; $1.50 per issue.

Bulletin of the International Institute of Social History, No. 1, 1954. (In English.) E. J. Brill, Oude Rijn 33a, Leiden, Netherlands. Triannually. About $2 per year.

The Bulletin of the Yamaguchi Medical School, vol. 1, No. 1, Feb. 1953. (In English, French, and German.) Yamaguchi Medical School, Ube, Yamaguchi, Japan. One vol. of 3 or 4 issues will be published yearly. Subscriptions by exchange.

Cormil Inventor, vol. 1, No. 10, Aug. 1954. The magazine by inventors for inventors. Cormil Creators Club, P.O. Box 2052, Austin 11, Texas. Monthly. $10 per year (includes club services).

Disease-a-Month, 1st issue, Oct. 1954. Mark Aisner, Ed. Year Book Publishers, 200 E. Illinois St., Chicago 11, Ill. Monthly. $9 per year.

The Egyptian Economic & Political Review, vol. 1, No. 2, Oct. 1954. Commercial & Industrial Research Organization, 26 A Sherif Pasha St., Cairo, Egypt. Monthly. P.T. 10 per issue.

Experimenta, vol. 1, No. 1, June 1954. Abelardo P. Piovano, Ed. Departamento de Consulta y Experimentación Regional, Universidad Nacional de Cuyo, Mendoza, Argentina.

Indian Journal of Fisheries, vol. 1, Nos. 1 & 2, May 1954. N. K. Panikkar, Ed. Ministry of Food and Agriculture, Government of India (Order from Edi-

tor, Central Marine Fisheries, Research Station, Mandapam Camp P.O., S.I.Rly., India. R.7 A.8 (May issue).

Información Técnica, vol. 1, No. 2, June 1954. División de Investigación, Ministerio de Agricultura, Bogotá, Colombia.

Jikeikai Medical Journal, vol. 1, No. 1, Jan. 1954. (In English.) Tokyo Jikeika School of Medicine (Order from T. Nakao, Pharmacological Institute, Tokyo Jikei-kai School of Medicine, Minato-ku, Tokyo, Japan). One vol. of 3 or 4 issues will be published yearly. Subscriptions by exchange.

Journal of the Geological Society of Australia, vol. 1 for 1953 (issued June, 1954). M. F. Glaessner, Ed. The Society, Adelaide, South Australia (Order from O. A. Jones, Dept. of Geology, University of Queensland, Brisbane). £2 2s.

Journal für Hirnforschung, vol. 1, Nos. 1/2, 1954. Organ des Instituts für Hirnforschung und Allgemeine Biologie in Neustadt (Schwarzwald). Successor to *Journal für Psychologie und Neurologie.* Cecile and Oskar Vogt, Eds. Akademie-Verlag, Berlin W 8, Germany. Irregular. DM. 12 per issue; DM. 72 per vol. (6 issues).

Kumamoto Pharmaceutical Bulletin, No. 1, Feb. 1954. (In English.) Tetsuji Munesada, Ed. Pharmaceutical Faculty, University of Kumamoto, Ohemachi, Kumamoto, Japan.

Polish Technical Abstracts, No. 1, 1954. (In English and Russian.) Centralny Instytut Dokumentacji Naukowo-Technicznej, Warsaw, Quarterly.

Publicaciones del Departamento de Cristalografía Y Mineralogía, vol. 1, No. 1, Oct. 1953. Universidad de Barcelona, Barcelona, Spain.

Yonago Acta Medica, vol. 1, No. 1, July 1954. (In English, French, and German). Atsushi Takagi, Ed. Tottori University School of Medicine, 86 Nishimachi, Yonago, Tottori-Ken, Japan. Irregular.

Miscellaneous

Which Fate? a 20-min sound and color film produced by the National Society for Medical Research, is now available. The film contrasts the fate of dogs destroyed in public pounds with the fate of those dogs withheld from destruction and sent to scientific laboratories for use in medical research and teaching.

The movie is a straightforward presentation of **medical science's need for experimental animals.** Prints may be purchased for $205 each from the National Society for Medical Research, 208 North Wells St., Chicago 6, Ill.

The Smithsonian Institution has just received more than 1000 specimens of **Liberian fishes,** chiefly from salt and brackish water, that were obtained over a 2-yr period by George C. Miller of the Fish and Wildlife Service of the Department of the Interior. The collection contains many species and varieties hitherto not represented in the national collections, but its particular interest is in the differences it shows between the sea creatures of the eastern and western Atlantic. Superficially they may be quite similar; when studied, however, they are found to represent quite different types.

Copies of the report on the **Conference on the Role of Women's Colleges in the Physical Sciences** that was held at Bryn Mawr College last June are now available from the Department of Physics, Bryn Mawr College, Bryn Mawr, Pa.

The **American Medical Association** has announced that it is discontinuing its "seal of acceptance" that makers of drugs, foods, cosmetics, and other products have used in advertising. The seal was in the form of the statement: "Accepted for advertising in the publications of the American Medical Association."

Management Science, a new quarterly magazine concerned with scientific research of management problems, features in its first issue, that for October, surveys of recent research on inventory control and mathematical methods in production control; an explanatory article on linear programing; and scientific papers on production and transportation scheduling. The publication of *Management Science* is the result of effort during the past year on the part of a nationwide group of management analysts, social scientists, mathematicians, and engineers with common interests in the scientific analysis of management problems. A new professional society, the Institute of Management Sciences, was established in December 1953 to lay the groundwork for developing and coordinating the diverse technical and scientific fields and to publish a journal of scientific research on management.

C. West Churchman of Case Institute of Technology is managing editor of the journal, with Alan O. Mann, SKF Industries, Philadelphia, as business manager. Members of the editorial board and their primary fields of management science interest are George Brown, International Telemetering Corp., Los Angeles (statistics and electronics); M. L. Hurni, General Electric Co., New York (business); Daniel Katz, University of Michigan (psychology); A. Charnes, Carnegie Institute of Technology (mathematics); and J. Marschak, University of Chicago (economics).

Information concerning the journal may be obtained from Alan O. Mann, SKF Industries, Philadelphia 32, Pa. General information on the Institute of Management Sciences may be had from George Kozmetsky, secretary, care of Litton Industries, 336 N. Foothill Rd., Beverly Hills, Calif., or Alex Orden, associate secretary, care of Burroughs Corp. Research Center, Paoli, Pa.

Erratum: In the article "On the protection against alloxan diabetes by hexoses" by G. Bhattacharya in the 19 Nov. 1954 issue, page 842, the heading for the second column of Table 2 should read "Oxygen uptake (µlit O_2/30 min)."

Book Reviews

Successful Commercial Chemical Development. H. M. Corley, Ed. Wiley, New York; Chapman & Hall, London, 1954. xxv + 374 pp. $7.75.

After little more than a decade of formal existence, the Commercial Chemical Development Association has produced a book that is unique in several respects. It is a pioneering effort, the first book on the subject. It is a pooled effort, produced under the guidance of a book committee; each chapter is the work of a chapter committee with as many as 14 members. The book's purpose is

> . . . to document in one volume the most enlightened, present-day knowledge of the important principles of every essential step, as well as the pitfalls to be avoided, in selecting promising new chemicals and rapidly developing them to the stage of economic importance.

Its preparation has undoubtedly entailed more discussion and debate than the authors would care to reckon.

Regardless of whatever merits or defects the book may otherwise have, it marks a milestone of progress toward removing the mysticism and hocus-pocus from the art of discovering and developing important new chemical products and toward creating a systematized or engineered approach. The chapters are written by commercially practicing market developers speaking from the experience gained in putting into practice the methodology that has been evolved bit by bit by the more thoughtful practitioners.

The first three chapters trace the evolution of organized commercial chemical development, touch on the growth of the North American chemical industry, and devote some 20-odd pages to definitions of terms. From this point on, the remaining 18 chapters develop the various aspects of commercial chemical development.

Many of the factors to be considered in detail for the selection of projects that will lead to successful new products are listed, including raw material availability, plant and processing costs, suitability for the market anticipated, competition from other chemicals or chemical processes, patentability, toxicity, handling ease, and others. Obviously, many diverse skills need to be applied if the over-all program of new-product development is to be successful.

The successful marketing of chemical products requires application of many nonchemical skills. Careful attention must be applied to pricing, packaging, labeling, shipping, and any specialized marketing techniques. Several case histories illustrate the breadth of teamwork needed for successful commercial chemical development. The evolution and recent rapid growth of the chemical industry itself is illustration enough of the effectiveness of the practices described in this book.

The ground rules of successful commercial chemical development as presented here should prove useful guides to those whose business it is to translate laboratory findings into salable products. Further than that, the book will be helpful to the management of chemical enterprises, in showing how to establish the function, and to users of chemical products who are desirous of having new materials brought to their attention.

L. F. Marek
Arthur D. Little, Inc., Cambridge, Massachusetts

Animal Cytology and Evolution. M. J. D. White. Cambridge Univ. Press, New York, ed. 2, 1954. xiv + 454 pp. Illus. $8.50.

Of the half-dozen books of the past two decades that have gained so much praise for bringing together aspects of evolution, genetics, cytology, systematics, and paleontology, *Animal Cytology and Evolution* is one of the most highly regarded. The publication of its second edition, expanded, reorganized, and very largely rewritten, is as noteworthy an event for the cytologist as for the evolutionist.

As a lucid account and skillful summary of nuclear cycles, especially those with unusual chromosomal behavior, and as a guide to what is known of normal and abnormal chromosomes and chromosomal sets of animals, White's book is excellent and without any peer today. The completeness of coverage of the literature is remarkable, and the insight of the author with regard to his problems has given the whole work an admirable organization and structure. Whether or not personal views are congruent with White's, it is unlikely that any informed biologist will read this monograph without enjoyment, profit, and strong admiration for the author's accomplishment. Unless they are members of the majority group of evolutionists, however, biologists will no doubt expect more in the way of open-minded evaluation on the part of the author.

As *descriptive* cytology, no more could be asked of one whose goal is to discuss the bearing of animal cytology on evolutionary processes. As *interpretative* cytology, however, much more might fairly be expected in the way of balance, accuracy, and unbiased prose. White does not hesitate to ignore or give short shrift to arguments or evidence that are opposed to his own, and he is not always scrupulous in assigning credit where credit is primarily due (as, for example, when he comments on the suppression of crossing-over within and adjacent to heterozygous inversions). Nor is he unwilling to state as probable fact what is still open to serious question. Actually it remains to be shown, for example, that "the dark-staining bands in the salivary chromosomes clearly correspond to the chromomeres of ordinary mitotic [!] and meiotic chromosomes," that "there seems now no serious reason to doubt that each band does represent a single genetic

locus" and "that each chromomere is really a single gene," that genes and most centromeres are not subdivisible, and so on for many of the cardinal issues of chromosome cytology and genetics. Use of *probably*, where *possibly* or *perhaps* is more clearly in order, and other persuasive verbalisms, tend to impart an enormously favorable slant to the expression of White's views. Any who are concerned with specific conclusions or evaluations will do well to study the original papers.

Since stress is given to what is regarded as cytogenetic interpretations, it should be commented that *cytogenetic* has here a different connotation than usual. White generally and necessarily deals with cytology that is accompanied by an *ad hoc* and consistent genetic interpretation rather than cytology that is tested or corroborated by direct genetic data or experiment. As is so often the case in the writings of our modern evolutionists, natural selection as a cause is deduced from effect, and the resulting arguments and conclusions are, of course, unconvincing.

KENNETH W. COOPER
Biology Department, University of Rochester

Life on Other Worlds. Harold Spencer Jones. English Universities Press, London, rev. ed. 2, 1954. xi + 259 pp. Plates. $3. (U.S. distrib., Macmillan, New York.)

In this little book, Harold Spencer Jones summarizes in a lucid way the knowledge pertinent to this fascinating question. The first chapter presents a summary of our present ideas on the structure of the universe. Then comes a discussion of conditions necessary for life. This is largely concerned with the unique chemistry of the carbon compounds. The author next describes the available methods of investigation, including the theory of escape of atmospheres, spectrographic analysis of planetary atmospheres, and means of determining planetary temperatures. After a discussion of the probable evolution of the atmospheres of Earth, he considers worlds without atmospheres and then, at the other extreme, the giant planets. Separate chapters are devoted to Venus and to Mars. Finally, theories of the origin of the solar system are considered. A concluding chapter points out the implications of the evidence developed.

This book is obviously written for the intelligent amateur and for scientists other than astronomers who wish an authentic summary of the information bearing on this topic. Quite naturally, therefore, the professional astronomer will find little with which he is not already familiar. However, the clarity of style and the skill with which concepts are completely and concisely developed make this book one that can be read with profit by anyone engaged in teaching an introductory course in astronomy, and it can provide valuable collateral reading for students in such courses. Inevitably, a book last revised in 1951 is out of date in certain details, but the nature of the treatment is such that this in no way vitiates the general theme.

In general, this book succeeds admirably in its purpose of presenting a summary of the solid scientific information bearing on the ever tantalizing question of whether life exists on worlds other than this.

FRANK BRADSHAW WOOD
Astronomy Department, University of Pennsylvania

Quantum Mechanics. P. Mandl. Academic Press, New York; Butterworths, London, 1954. viii + 233 pp. Illus. $5.80.

The field of quantum mechanics is already blessed with a number of excellent textbooks. Nevertheless, F. Mandl's book is a welcome addition to this list. Apart from elementary "first courses" on wave mechanics and from specialized treatises on specific applications of quantum theory, most previous textbooks fall in two classes. The first group contains very readable books concentrating on the underlying physical principles and the practical use of quantum mechanics, such as the American textbooks by Bohm and by Schiff. The second group concentrates on the rigorous mathematical foundations of quantum mechanics, for example, the classic works by Dirac and by von Neumann. These works, although important original contributions, are by no means easy reading for the theoretical student and experimental physicist. Mandl's book is also designed to bring out the unifying mathematical scheme underlying quantum mechanics. It deals with the more formal aspects of the theory but without undue stress on rigor and without assuming any elaborate mathematical training on the part of the reader. Only the nonrelativistic theory is treated throughout.

In the first five chapters the mathematical formalism of quantum mechanics is developed in detail, with particular attention to its physical interpretation rather than to practical applications. After a chapter on mathematical techniques, the concepts of wave mechanics in general and eigenfunctions in particular are introduced. A thorough and clear treatment of matrix mechanics and of the general operator formalism follows. Especially welcome is a discussion of the measurability of operators and related questions of observation.

The remaining four chapters deal with specific applications, but from a point of view somewhat different from that of most previous books on a comparable level. The main aim of these sections is to illustrate the use of the general theory, rather than to obtain theoretical results in various branches of physics. Included are treatments of angular momentum operators and their application to systems of many particles, of the perturbation method, and of collision theory. The book ends with a discussion of group-theoretic methods. This discussion is noteworthy for its simplicity, not usually found in treatments of group theory. The book's usefulness is enhanced by a collection of exercises, together with hints for their solution.

Quantum Mechanics probably should not be considered as a textbook for the more standard courses

on quantum mechanics taught at American universities, with their emphasis on the practical aspects of the theory. In fact many standard topics (such as details of the wave functions of the hydrogen atom and phase-shift analysis in scattering theory) are hardly treated at all and the reader is referred to books such as the one by Schiff. But Mandl's book will be very useful to anyone who wants a simple, but systematic and self-contained, exposition of the formal aspects of quantum mechanics and of the mathematical techniques used in its application.

E. E. SALPETER
Laboratory of Nuclear Studies, Cornell University

Characteristics and Applications of Resistance Strain Gages. Proceedings of NBS symposium held 8–9 Nov. 1951. National Bureau of Standards, Washington, D.C., 1954. iv + 140 pp. Illus. $1.50. (Order from Supt. of Documents, GPO, Washington 25, D.C.).

As of the date of the symposium, these papers consisted of the latest experimental results with respect to resistance strain gages and the latest attendant theoretical considerations. They were contributed, not only by leading experts in the United States, but by such well-known foreign personalities as R. G. Boiten of Delft, Holland, G. V. A. Gustafsson of Ulvsunda, Sweden, and A. U. Huggenberger of Zurich, Switzerland.

The papers cover a variety of topics and include the application of strain gages to measurement of mechanical quantities (acceleration, impact forces, and dynamic pressure), as sensing elements in the field of instrumentation, and to determination of the strain in concrete by imbedding techniques. Also, as of the date of the symposium, new work in progress is reported, including such applications as strain sensitivity in conducting coatings and strain gages in commercial weighing.

A valuable part of the book is the inclusion of discussions that followed presentation of the papers.

GEORGE L. KEHL
Department of Metallurgy, Columbia University

Physical Chemistry. Based on *Physische Scheikunde.* A. J. Rutgers. Interscience, New York–London, 1st Eng. ed., 1954. ix + 804 pp. Illus. $8.50.

The thoroughness of Rutgers' treatment of the fundamental principles of physical chemistry is indicated in part by the inclusion of a chapter on classical theoretical mechanics, in which the importance of the phase integrals is pointed out before the introduction of Bohr's quantum postulates and the development of wave mechanics. The chapters on thermodynamics also exhibit a high standard of pedagogy (although, in the discussion of temperature scales, the identity of the thermodynamic and ideal gas scales is not recognized).

In an attempt at completeness, a chapter on the physical chemistry of high polymers, written by Turner Alfrey, has been appended. Nevertheless, a number of important topics have been treated either very briefly or not at all. For example, little space is devoted to quantum mechanical valence theory. In the chapter on the Einstein and Debye theories of the specific heats of crystals, no mention is made of the computations of frequency distributions in crystals by Blackman and others. No reference is made to Hildebrand's treatment of regular solutions or to extensions of the Debye-Huckel theory of strong electrolytes.

In spite of these and other omissions, the meticulous presentation of the topics covered should prove valuable to any student of physical chemistry. The translation, although generally good, is awkward in places. The recurring phrase "we follow" for "it follows that" in some of the derivations should certainly have been corrected before publication. There are a number of typographical errors, but these should not cause any misunderstanding of the text.

JERRY BRAUNSTEIN
Department of Chemistry, University of Maine

Highway Engineering. Laurence I. Hewes and Clarkson H. Oglesby. Wiley, New York; Chapman & Hall, London, 1954. xi + 628 pp. Illus. $8.

This volume is an excellent, comprehensive book intended for a textbook in highway engineering. In this respect it is entirely satisfactory. The junior or senior engineering student being introduced to highway engineering for the first time will find it completely comprehensible. The ambiguous and often confusing verbiage found in technical engineering books is conspicuous by its absence here; hence, the subject matter is presented clearly and simply without the necessity of long interpretations.

Although the volume is long for presentation in a one-year course it is so written that it may readily be adapted as such. It is ultramodern and completely up to date with the latest features of current superhighway design and construction included.

The documentation of the materials in the book is complete with references to source matter indicated at the bottom of the page, close to the text. Tables, charts, and diagrams are used profusely and are invariably clear, simple, and easy to follow and interpret.

The book approaches the details of design and construction after an orderly introduction to highway systems, planning, economy, finance, and other fundamental chapters. Those on highway economy and finance are particularly excellent. Many of the chapters have contributions by various members of the U.S. Bureau of Public Roads. The effect of these and other collaborators has been to eliminate prejudice and regional emphasis.

The practicing highway engineer will find it a valuable investment of his time to review this book and its systematic development of current practice. It will not only prove to be a "refresher" course but should

provoke profound interest. The soils and geological engineers too will find many worth-while chapters affording a stimulating and instructive background to their own specialties in relationship to highway work. The layman and the legislator alike would profit by an examination of the book and gain thereby an appreciation of the problems involved in highway construction and the great progress made, especially in the past 35 years.

ARTHUR B. CLEAVES
Department of Geology and Geological Engineering, Washington University

Clinical Aspects of the Autonomic Nervous System. L. A. Gillilan. Little, Brown, Boston. xii + 316 pp. Illus. $6.50.

This book is intended to furnish a summary of the knowledge of the anatomy and physiology of the autonomic nervous system as a background for clinical practice. This purpose is not achieved, because, whereas the anatomical summary is adequate, particularly with regard to gross anatomy, the physiological data and theories are presented incompletely, deficiently, and often erroneously.

As examples of these errors I mention the statement (p. 161) that "certain tissue products such as acetylcholine and histamine . . . produce generalized vasodilation of coronary and peripheral vessels," coupled with the further statement that "epinephrine and ephedrine are peripheral vasoconstrictors and coronary vasodilators." Although the chemical mediation of coronary vasodilators and constrictors has not been unanimously settled, there is unanimous agreement that either acetylcholine or adrenaline leads to constriction. As another example I quote the statement (pp. 20–21) that "it is believed that mass release of acetylcholine at the myoneural junction brings about generalized contraction of the voluntary musculature." High concentrations of acetylcholine lead to paralysis, not to contractions.

In the classification of autonomic disturbances and body types, the author accepts the now generally discarded criterions of Eppinger and Hess, of Danielopolu, and of Martinet (not quoted in the bibliography) of sympathicotonia, amphotonia, and vagotonia. I fail to find "a striking parellelism" between this classification and all the others grouped in Table 1.

A salient flaw in the book is a striking negligence to give appropriate credit to many investigators and the giving of undue credit to others. Thus, I disagree with the assertion that "the autonomic nervous system got its first firm footing in medicine when Peet (1935) devised his operation for relief of hypertension." The basis of our knowledge of the chemical transmission of nerve impulses is Loewi's study of the heart, not Dale's work on acetylcholine. The generally accepted theory of hunger was proved by Cannon and Washburn (1912), not by Carlson. The role of the sympatho-adrenal system in emotions was not an "obvious" anonymous contribution (p. 84); it was first emphasized and later beautifully analyzed by Cannon.

ARTURO ROSENBLUETH
Department of Physiology, National Institute of Cardiology of Mexico

Rural Electrification. vols. I and II. United Nations Economic and Social Council, Geneva, Switz., 1954. vol. I, ii + 163 pp. + tables. Plates. Paper, $1.50. vol. II, ii + 165 pp. Plates. Paper, $1.25. (U.S. distrib.: Columbia Univ. Press, New York.)

This two-volume work, representing the collective rural electrification experience of 14 nations, is an excellent compendium of modern knowledge in this specialized field. The material is admirably organized to accomplish its avowed purposes of (i) making available to relatively less industrialized nations the special techniques that have proved successful in bringing central station electric service to farms throughout the world, and (ii) providing nations already advanced in rural electrification with a means of measuring their own techniques and progress against the achievements of the rest of the world. In addition, a diversified pool of knowledge is made available for the benefit of all nations.

The material is not limited to discussions of broad principles. Its value is not curtailed by any attempt to avoid technical terminology or mathematical analysis where these are applicable. The volumes are well worth study by any agency responsible for initiating, redeveloping, or expanding a national or regional rural electrification program. Volume I provides specific details on proved principles of design applicable to network planning, rural distribution facilities, and small local thermal and hydroelectric generating stations. There is also considerable specific data covering experience with respect to cost and rate structure design.

The early rural electric system design engineers pioneered new construction standards and techniques in order to reduce line construction costs to a point where the relatively sparsely settled rural areas could be economically served. In this endeavor, mistakes were, of course, made in both electrical and mechanical construction practices. These mistakes effectively increased the cost of original facilities in many instances. Present-day higher price levels make it almost mandatory that these early mistakes not be repeated, and a careful review of the comprehensive experience of 14 nations well established in the technology will be of great advantage to present designers in striking an optimum balance between low initial costs on one hand and reasonable maintenance charges and flexibility for growth on the other.

One of the very few faults of the work is the absence of an index and a consequent inability to locate material on specific topics without excessive thumbing. This lack is somewhat compensated for in volume II by the inclusion of a table of contents with chap-

ters subdivided according to process designation, that is, milk production, poultry production, pig rearing, fruit handling, and so forth.

Volume II is completely devoted to the application of central station electric service to nearly every branch of agricultural activity and contains a tremendous quantity of valuable empirical data, design information, and specifications on the sizes of electric loads imposed by the variety of farm chores susceptible to performance by electric methods. Volume II is a classic in the field of what is generally known as "power use"—an activity that includes all endeavor designed to develop additional load for electric systems serving rural areas.

CHARLES A. ROBINSON, JR.
National Rural Electric Cooperative Association

Reports on Progress in Physics. vol. XVII (1954). A. C. Stickland, Exec. Ed. Physical Society, London, 1954. 280 pp. Illus. £2 10s.

This volume, like the preceding ones, is remarkable because of the wide range of problems discussed. M. H. L. Pryce (now at Bristol) treats a subject that is of great interest to all theoretical and experimental nuclear physicists—the nuclear shell model. The theory of the origin of the cosmic ray is discussed by Edward Teller (University of California, Berkeley), showing that the random acceleration process (Fermi) and location of the accelerating fields in radio stars (Unsöld) can account for the main features of cosmic radiation. Solid-state physics is represented by the article on Antiferromagnetism, by A. E. Lidiard (Berkeley, Calif.). Readers interested in the properties of the various compounds in which antiferromagnetism has been observed will welcome the table (p. 240) that summarizes the various properties that have been studied and how they are related to antiferromagnetic structure. Chemical physics is represented by "Atomic valence states and chemical binding," by W. Moffitt (Harvard).

Atmospheric electricity was reviewed by J. Alan Chalmers (London). This is welcome, since much new work in this field has been carried out in recent years. It would have been even more interesting if this article had been illustrated. C. W. Allen (University of London Observatory), in his discussion of the physical condition of the solar corona, touches on problems that are of interest not only to astrophysicists but also to the physicists interested in "plasma physics" (gaseous discharges and high-temperature physics).

Investigation in the ionosphere is a field of physics that is particularly well supported in England and the paper on the horizontal movements in the ionosphere, discussed by E. H. Briggs and M. Spencer of the Cavendish Laboratory in Cambridge, is a valuable contribution to our knowledge on ionosphere movements based on radio methods.

Microwave investigations during the war have stimulated interest in the solution of the classical diffraction problem. This work, which was, among others, developed by Bethe, Schwinger, and their collaborators in this country, by Meixner and Buchholz in Germany, and by the author in Holland, is presented in a masterly summary with over 500 references, by C. J. Bouwkap (Philips Research Laboratories, Eindhoven, Netherlands).

KARL LARK-HOROVITZ
Department of Physics, Purdue University

The Identification of Organic Compounds. A manual of qualitative and quantitative methods. Stig Veibel. Gad, Copenhagen, ed. 4 (1st Eng. ed.), 1954. xv + 346 pp. Illus.

Three Danish editions have preceded the present English language edition of this well-constructed, up-to-date manual on the identification of organic compounds. Here are combined in one convenient volume the qualitative and quantitative aspects of the subject. The first three chapters deal with purification and determination of physical properties, detection and estimation of the elements, and solubility tests. The remainder of the book offers a wide and critical selection of the available methods for detection and quantitative determination of all the principal functional groups and for identification of organic compounds through derivatives. Only in the treatment of aromatic hydrocarbons do I feel that the book falls short.

The manual was originally prepared for use at the University of Copenhagen and the University of Technology of Copenhagen by students who were devoting about 40 (5-hour) working days to the course on identification. Designed for the mature student, it does not provide lists of compounds and derivatives found in many treatments of qualitative organic analysis. Instead, the student is referred to Beilstein and the abstract literature and is provided with references to papers in which melting points of derivatives are given. All specific procedures are documented, and the author, whose contributions to the original analytic literature have been ample and varied, adds valuable experience from his own laboratories to the documentation. He does not lead the student by the hand; moreover, he permits the student to realize, through brief documented discussions, that a variety of methods are often available for studying any one functional group, and that he need not restrict himself to the recommended procedures that are described in detail in the manual. The total approach can only develop a sound understanding of the problems involved in identification.

Few of our colleges and universities offer integrated courses of the type for which this manual is written. However, anyone planning to institute such a course could well consider this neat, succinct, but comprehensive, treatment.

FRANCES BERLINER
Department of Chemistry, Bryn Mawr College

Books Reviewed in THE SCIENTIFIC MONTHLY

April

The North American Prairie, John E. Weaver (Johnsen). Reviewed by P. B. Sears.

The Judgment of History, Marie Collins Swabey (Philosophical Library). Reviewed by D. H. Thomas.

The Story of Man, Carleton S. Coon (Knopf). Reviewed by R. W. Ehrich.

Indian Corn in Old America, Paul Weatherwax (Macmillan). Reviewed by Edgar Anderson.

Graphic Problems in Petroleum Geology, L. W. LeRoy and Julian W. Low (Harper). Reviewed by T. J. Parker.

Introduction to Vertebrate Embryology, ed. 5, and ***A Laboratory Manual of Vertebrate Embryology,*** ed. 3, Waldo Shumway and F. B. Adamstone (Wiley). Reviewed by J. Oppenheimer.

Africa Drums, rev. ed., Richard St. Barbe Baker (British Book Centre). Reviewed by W. A. Dayton.

Back of History, William Howells (Doubleday). Reviewed by C. E. Snow.

General College Chemistry, rev. ed., M. Cannon Sneed, J. Lewis Maynard, and Robert C. Brasted (Van Nostrand). Reviewed by J. A. Timm.

Fundamentals of College Mathematics, John C. Brixey and Richard V. Andree (Holt). Reviewed by H. G. Russell.

General Chemistry, Edwin C. Markham and Sherman E. Smith (Houghton Mifflin). Reviewed by F. D. Martin.

The Kachina and the White Man, Frederick J. Dockstader (Cranbrook). Reviewed by E. A. Hoebel.

Proceedings of the Seventh International Botanical Congress, Hugo Osvald and Ewert Aberg, Eds. (Chronica Botanica). Reviewed by J. R. Swallen.

History of American Industrial Science, Courtney Robert Hall (Library Pub.). Reviewed by C. G. Suits.

Nomography and Empirical Equations, Lee H. Johnson (Wiley). Reviewed by K. D. Miller, Jr.

Nobel Prize Winners in Physics: 1901–1950, Niels H. de V. Heathcote (Schuman). Reviewed by R. M. Sutton.

Saipan: The Ethnology of a War-Devastated Island, Alexander Spoehr (Chicago Natural History Museum). Reviewed by F. M. Keesing.

Community and Environment, E. A. Gutkind (Philosophical Library). Reviewed by N. E. Collias.

The Rise and Fall of Maya Civilization, J. Eric S. Thompson (Univ. of Oklahoma Press). Reviewed by L. Satterthwaite.

Mineral Nutrition of Fruit Crops, Norman F. Childers, Ed. (Rutgers). Reviewed by P. C. Duisberg.

The Physician and His Practice, Joseph Garland, Ed. (Little, Brown). Reviewed by M. H. Bauersfeld.

Psychology: The Unity of Human Behavior, Timothy J. Gannon (Ginn). Reviewed by E. L. Kelly.

The Pharmacologic Principles of Medical Practice, J. C. Krantz, Jr., and C. Jelleff Carr (Williams and Wilkins). Reviewed by C. F. Schmidt.

Indians of the Plains, Robert H. Lowie (McGraw-Hill). Reviewed by M. W. Stirling.

An Introduction to the Study of Insects, Donald J. Borrer and Dwight M. DeLong (Rinehart). Reviewed by C. H. Richardson.

Insect Fact and Folklore, Lucy W. Clausen (Macmillan). Reviewed by G. K. McCosh.

Microbes and You, Stanley E. Wedberg (Macmillan). Reviewed by R. McC. Jones.

Intertidal Invertebrates of the Central California Coast, R. I. Smith *et al.* (Univ. of California Press). Reviewed by P. L. Illg.

New Books

University Physics. Based on Sears' 3-vol. *Principles of Physics,* with supplementary problems. Francis Weston Sears and Mark W. Zemansky. Addison-Wesley, Cambridge 42, Mass., complete edition (ed. 2), 1955. 1031 pp. $8.50.

Applied X-rays. George L. Clark. International Ser. in Pure and Applied Physics. Leonard I. Schiff, Consulting Ed. McGraw-Hill, New York–London, ed. 4, 1955. 843 pp. $12.50.

The Tree of Culture. The late Ralph Linton. Knopf, New York 22, 1955. 692 pp. $5.75.

Bibliography of Geology Theses. Colleges and Universities of the United States. Compiled by Daniel S. Turner. Petroleum Research Libraries, Denver, 1954. 482 pp. Paper, gratis.

Qataban and Sheba. Exploring the ancient kingdoms on the Biblical spice routes of Arabia. Wendell Phillips. Harcourt, Brace, New York 17, 1955. 362 pp. $5.

Organic Syntheses. Collective vol. 3 (rev. ed. of annual vols. 20–29). E. C. Horning, Ed. Wiley, New York 16; Chapman & Hall, London, 1955. 890 pp. $15.

A Symposium on Amino Acid Metabolism. Sponsored by McCollum-Pratt Inst. of The Johns Hopkins Univ. William D. McElroy and H. Bentley Glass, Eds. Johns Hopkins Press, Baltimore 18, 1955. 1048 pp. $12.50.

Cultural Anthropology. An abridged revision of *Man and His Works.* Melville J. Herskovits. Knopf, New York 22, 1955. 569 pp. $5.

Financing Hospital Care in the United States. vol. 3, *Financing Hospital Care for Nonwage and Low-Income Groups.* Harry Becker, Ed. Blakiston Div., McGraw-Hill, New York–London, 1955. 110 pp. $2.50.

Isotope Geology. Kalervo Rankama. McGraw-Hill, New York 36; Pergamon Press, London, 1955. 535 pp. $12.

Theories of Perception and the Concept of Structure. A review and critical analysis with an introduction to a dynamic-structural theory of behavior. Floyd H. Allport. Wiley, New York 16; Chapman & Hall, London, 1955. 709 pp. $8.

American Men of Science. vol. I, *Physical Sciences.* A biographical directory. Jaques Cattell, Ed. Science Press, Lancaster, Pa. and Bowker, New York 36, ed. 9, 1955. 2180 pp. $20.

Handbook of Algae. With special reference to Tennessee and the Southeastern United States. Herman S. Forest. Univ. of Tennessee Press, Knoxville 16, 1954. 467 pp. $4.75.

La Végétation de Kaniama (Entre-Lubishi-Lubilash, Congo Belge). Série Scientifique No. 61. William Mullenders. Institut National pour l'Étude Agronomique du Congo Belge, Brussels, Belgium, 1954. 499 pp. Paper, F. 180.

Obituary Notices of Fellows of the Royal Society. vol. 9. Royal Soc., London, W.1, 1954. 264 pp. 30s.

World Outside My Door. Olive Bown Goin. Macmillan, New York 11, 1955. 184 pp. $3.50.

Pathology of the Dog and Cat. The genitourinary system, with clinical considerations. Frank Bloom. American Veterinary Publ., Evanston, Ill., 1954. 463 pp. $12.

Outlines of Enzyme Chemistry. J. B. Neilands and Paul K. Stumpf. Wiley, New York 16; Chapman & Hall, London, 1955. 315 pp. $6.50.

The Equatorie of the Planetis. Edited from Peterhouse manuscript 75.I (a manuscript treatise ascribed to Chaucer). Derek J. Price, Ed. Linguistic analysis by R. M. Wilson. Cambridge Univ. Press, London–New York 22, 1955. 214 pp. $10.

Insects of Micronesia. vol. 1, Introduction. J. Linsley Gressitt. Bernice P. Bishop Museum, Honolulu 17, 1954. 257 pp.

Two Ears of Corn, Two Blades of Grass. D. H. Killeffer. Van Nostrand, New York 3, 1955. 139 pp. $4.

Art in Science. A portfolio of 32 paintings, drawings, and photographs from *Scientific American*, with an introductory essay on the interrelations of art and science by György Kepes. Simon and Schuster, New York, 1954. $6.

Culture and Human Fertility. A study of the relation of cultural conditions to fertility in non-industrial and transitional societies. Frank Lorimer. UNESCO, Paris, 1954 (Distr. by Columbia Univ. Press, New York 27). 514 pp. Paper, $4.50.

Advanced Mathematics for Engineers. H. W. Reddick and F. H. Miller; rev. by F. H. Miller. Wiley, New York 16; Chapman & Hall, London, ed. 3, 1955. 548 pp. $6.50.

Trigonometry. Roy Dubisch. Ronald Press, New York 10, 1955. 396 pp. $5.

How to Solve Problems in General Chemistry. Joseph A. Babor and Chester B. Kremer. Crowell, New York 16, ed. 2, 1955. 152 pp. Paper, $1.25.

The Evolution of an Insect Society. Derek Wragge Morley. Scribner's, New York 17, 1955. 215 pp. $3.95.

Multipole Fields. M. E. Rose. Structure of Matter Ser. Maria G. Mayer, Advisory Ed. Wiley, New York 16; Chapman & Hall, London, 1955. 99 pp. $4.95.

Nuclear Physics. Alex E. S. Green. International Ser. in Pure and Applied Physics, Leonard I. Schiff, Consulting Ed. McGraw-Hill, New York–London, 1955. 535 pp. $9.

Thomas Bradwardine: His Tractatus de Proportionibus. Its significance for the development of mathematical physics. Edited and trans. by H. Lamar Crosby, Jr. Univ. of Wisconsin Press, Madison, 1955. 203 pp. $3.50.

The Monagrillo Culture of Panama. vol. XLIX, No. 2, Papers of the Peabody Museum of Archaeology and Ethnology, Harvard Univ. Gordon R. Willey and Charles R. McGimsey. Appendix on *Archaeological Marine Shells*, Robert E. Greengo. The Museum, Cambridge 38, Mass., 1954. 158 pp. Paper, $4.65.

Chemistry and Chemical Technology of Cotton. Kyle Ward, Jr., Ed. Interscience, New York–London, 1955. 782 pp. $20.

Annual Report of the Librarian of Congress for the Fiscal Year Ending June 30, 1954. Library of Congress, Washington 25, 1955 (Order from Supt. of Documents, GPO, Washington 25). 178 pp.

Introducing Sea Shells. A colorful guide for the beginning collector. R. Tucker Abbott. Van Nostrand, New York–London, 1955. 64 pp. Paper, $2.50.

Further Contributions to the Solution of the Piltdown Problem. J. S. Weiner *et al.* Geological Ser., vol. 2, No. 6. British Museum (Natural History), London, 1955. 60 pp. Paper, £1.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to *Science*, but to the publisher or agency sponsoring the publication.)

Fish Spermatogenesis with Particular Reference to the Fate of the Cytoplasmic Inclusions. pt. III, Spermatogenesis of Actinopterygii (Cyprinodontidae). Res. Bull., Zoology, No. 62. Hem Sagar Vasisht. Panjab Univ., Hoshiarpur, India, 1954. 6 pp. Re. 1-2-0.

Natural History of the Salamanders of the Plethodontid Genus Ensatina. Robert C. Stebbins. Univ. of California Press, Berkeley 4, 1954. 77 pp. $1.25.

Notropis Baileyi, *a New Cyprinid Fish from the Pascagoula and Mobile Bay Drainages of Mississippi and Alabama.* Tulane Studies in Zoology, vol. 2, No. 5. Royal D. Suttkus and Edward C. Raney. Tulane Univ., New Orleans, 1955. 16 pp. $0.30.

Cheyenne Mountain Tropospheric Propagation Experiments. NBS Circ. 554. Natl. Bur. of Standards, Washington 25, 1955 (Order from Supt. of Documents, GPO, Washington 25). 39 pp. $0.35.

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Technical Papers

Molting of Roaches without Prothoracic Glands

L. E. Chadwick

Chemical Corps Medical Laboratories, Army Chemical Center, Maryland

The prothoracic glands (p.g.) of insects are commonly regarded as essential for the initiation of molting and metamorphosis. This view is well supported (*1*), but on analysis the evidence, although it is extensive, proves to have been derived mainly from one type of experiment in which glandular tissue is implanted into body parts that lack the p.g., and the molting of these parts is taken as proof of p.g. function. Technical difficulties have in the past prevented the alternative approach of extirpating the p.g. in immature individuals.

In roaches, the glands were first identified on histological grounds by Scharrer (*2*) as a flat layer of cells investing a pair of slender prothoracic muscles. That these structures could induce molting was demonstrated by Bodenstein (*3*), who implanted them into adults, which then molted, although ordinarily they never do so because their own p.g. have degenerated. The success of such experiments was the result of the discovery (*3*) that regression of the p.g. could be prevented by removing the corpora allata.

In contrast with many other insects, the location and structure of the p.g. in roaches encouraged the belief that these glands could be removed from immature specimens without killing them. This note reports the outcome of such operations.

The procedure is the relatively simple one of cutting three of the peripheral attachments and pulling the glands out by means of the fourth. The principal difficulties are that the glands are hard to see and that they are frequently attached by fine tracheae to other tissues, with the result that they are likely to break when removal is attempted. Nevertheless, they may be removed easily from a fair proportion of individuals.

From some 200 operations attempted on nymphs of *Periplaneta americana* L., 80 specimens survived with what were considered complete extirpations. These were held individually for observation; to my surprise, most of them presently proceeded to molt. In fact, no difference could be detected between their molting behavior and that of various types of controls, which included unoperated individuals, animals with sham operations, others with reimplanted glands, still others with partial extirpations or with added supernumerary glands, and so on (Table 1). Many of the p.g.-less specimens molted on a normal schedule through several instars and became normally reproductive adults.

Table 1. Removal of prothoracic glands: molting behavior in the first postoperative instar.

Diagnosis	Total	Died	Molted to adults	Molted to nymphs	Percentage molting
Extirpation complete	80	7	13	60	91
Extirpation probable	7	0	0	7	100
Extirpation partial	15	3	1	11	80
Sham operation	10	2	0	8	80
Reimplanted p.g.	19	2	0	17	89
Extra p.g. implanted	5	0	2	3	100
Unoperated controls	20	0	4	16	100

In view of these results, and assuming that molting in the nymphal roach follows the usual sequence in which the p.g. are stimulated by the periodically activated brain to release a substance that evokes the molting response, we are forced to conclude that Scharrer's organ cannot be the only source of p.g. hormone in immature *Periplaneta*. There is at present no evidence to indicate what the supplementary source may be, and it appears that considerable further experimentation will be required for its identification. Meanwhile, these observations serve to emphasize the fact that hormonal relationships in insects are actually more intricate than is sometimes assumed in schemes constructed on the basis of the limited types of data currently available.

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X-ray Examination of Molecular Configuration of Asparagine in Crystalline L-Asparagine Monohydrate

Yoshihiko Saito,* Octavio Cano-Corona,† Ray Pepinsky

X-Ray and Crystal Analysis Laboratory, Department of Physics, Pennsylvania State University, University Park

Although asparagine and glutamine are similar with regard to the presence and arrangement of the three functional groups $-NH_2$, $-COOH$, and $-CONH_2$ and differ only by the existence of one more methylene group in glutamine, differences exist in their properties and behavior that would not be expected of true homologs. These differences have been summarized by Steward and Thompson (*1*). Crystalline glutamine has a straight-chain form (*2*).

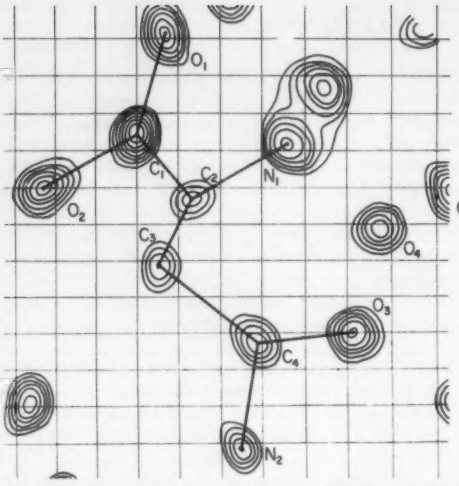

Fig. 1. Electron density map of asparagine monohydrate, projected on y-z plane, with molecule superposed.

Steward and Thompson have suggested that the properties of asparagine may be due to the formation of a cyclic structure, with the carboxyl combined in the ring; and they indicate how some aspects of the behavior of this molecule may be accounted for by such a structure. Huggins (*3*) has suggested an alternative structure in which the carboxyl and amide groups are coiled so that these two groups are in proximity.

At the suggestion of Steward (*4*), an x-ray structure analysis of asparagine has been carried out, in the hope that information might be derived which would shed light on the differences in behavior between asparagine and glutamine. The cell and symmetry of asparagine were first reported by Bernal (*5*), but his analysis was not carried to the point where the molecular shape and association could be established.

Single-crystal patterns from the L-asparagine monohydrate $C_4H_8O_3N_2 \cdot H_2O$ (*4*) provide the following information: (i) $a = 5.58 \pm 0.01$ A, $b = 9.83 \pm 0.02$ A, and $c = 11.81 \pm 0.02$ A; (ii) space group $P2_12_12_1$; and (iii) 4 molecules per cell. Three-dimensional data have been collected with CuKα radiation and a Weissenberg camera. Interpretation of a three-dimensional Patterson map, computed on X-RAC (*6*), provided a successful trial structure. Successive refinement of an electron density projection on (100), using X-RAC and S-FAC alternately, resulted in the electron density contour map shown in Fig. 1. All atoms are clearly resolved, and the y and z parameters are sufficiently accurate to permit calculation of a three-dimensional density distribution, which is now being refined.

From the (100) projection of Fig. 1 and packing considerations, the general features of the structure are clear. The succinic acid part of the molecule is in a trans-configuration. A similar configuration is found by Pasternak, Katz, and Corey (*7*) in glycyl-L-asparagine. The structure is held together by a three-dimensional network of hydrogen bonds. A water molecule appears nearly at the center of a tetrahedron formed by three oxygen atoms and the nitrogen atom of the α-amino group.

Even in its present stage, this analysis clearly reveals that the cyclic structure is not present in the crystalline monohydrate. This, of course, does not establish that such a cyclic configuration is impossible in solution.

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* On leave from department of chemistry, Osaka City University, Oogimachi, Osaka, Japan.

† Rockefeller Foundation fellow, on leave from University of Mexico.

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4. We are grateful to Steward for suggesting the problem and furnishing material for the study; to the Rockefeller Foundation for a fellowship for one of us (O. C.-C.); to the National Institutes of Health, Institute of Arthritis and Metabolic Diseases, for grant A-228 under which much of the research was conducted; and to the Office of Naval Research, contract No. N6onr-26916, T. O. 16, for support of calculations on X-RAC and S-FAC. We also thank P. F. Eiland for much helpful advice.
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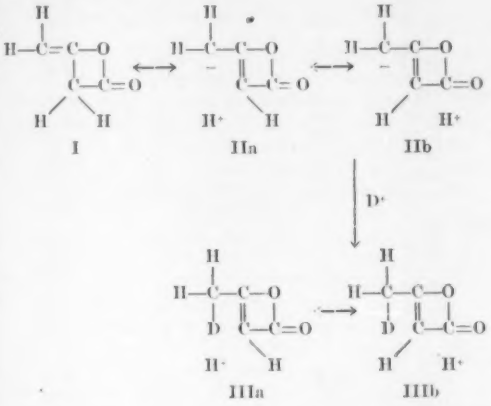
Hyperconjugation in Ketene Dimer

Richard H. Wiley

Department of Chemistry, College of Arts and Sciences, University of Louisville, Louisville, Kentucky

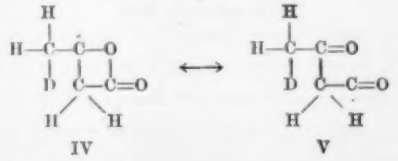
The 3-butenoic β-lactone structure (I) for diketene is fairly conclusively established by ozonolysis, which gives formaldehyde and malonic acid (*1*); by bromination with N-bromosuccinimide, which gives only β-bromoacetoacetic derivatives (*2*); and by methanolysis with methanol-d, which gives only methyl γ-deuteroacetoacetate (*3*). Adequate explanations for the reactions of diketene based on the 3-butenoic β-lactone structure are necessary to complete the general acceptance of this structure because the acetylketene structural possibility offers such obvious and convenient explanations for most diketene reactions that there is a persistent tendency (*3, 4*) to use this acetylketene structure in describing diketene reactions. The purpose of this comment is to point out that hyperconjugation possibilities, along with transformations based on accepted analogies and resulting from such possibilities, which are present in the 3-butenoic β-lactone structure, provide a simple and previously unnoted explanation for diketene reactions.

Hyperconjugation possibilities in the 3-butene β-lactone structure (I) include contributions from two structures IIa and IIb, either of which permit attack by a positive fragment, such as the proton or deuteron, at the exocyclic methylene carbon atom to give IIIa–IIIb.



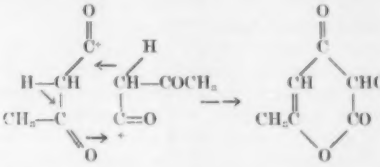
These hyperconjugation resonance structures involve no greater charge separation than previously considered resonance structures involving a cyclic oxonium atom. Moreover, since deuterium exchange with the hydrogen atoms involved in the "no-bonds" has been shown (*5*) to be nonexistent, such structures as IIIa–IIIb are entirely consistent with the absence of α-deuteration during the methanolysis with methanol-d. In fact, only after it is known that there is no exchange of α-hydrogen atoms with deuterium is it likely that these hyperconjugation structures would be seriously considered.

Conversion of IIIa–IIIb to IV represents the normal course of the mechanism of addition reactions in which hyperconjugation is involved. Reactions of IV, such as combination with a methoxide ion, will obviously not give the acetoacetate structures actually obtained. Rearrangement of IV to the acylonium ion V provides the structural entity that does explain acetoacetate formation. Analogies for the two steps involved in the rearrangement of IV to V are known. The conversion of a carbonium ion (in which the carbonium carbon is linked to an oxygen atom) to a carbonyl group is postulated as one step in the gen-



erally accepted mechanism for the pinacol rearrangement (*6*), and formation of an acylonium ion from an ester is postulated as one step in accepted mechanism for Friedel-Crafts acylations and for the sulfuric acid catalyzed hydrolysis of ethyl 2,4,6-trimethyl-benzoate (*7*).

The acylonium ion V is structurally similar to the acetylketene structure. It can be regarded as the product formed by addition of a proton to acetylketene. The result is that the ease and convenience associated with reaction concepts based on acetylketene are readily transferred to concepts based on this conversion. For example, the formation of dehydroacetic acid from diketene can be formulated as follows:



Acceptance of this hyperconjugation-acylonium ion concept for the structure and reactions of 3-butenoic β-lactone will permit clarification of much of the confusion in the literature on diketene reactions.

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15 November 1954.

Blood Studies of Red Sindhi-Jersey Crosses: III. Effect of a Fixed Hot Environment on Blood Constituent Levels of Jerseys and Sindhi-Jersey Crosses

L. L. Rusoff, M. W. Schein, J. J. Vizinat*

Louisiana Agricultural Experiment Station, Baton Rouge

One of the principal problems in the general program of developing strains of dairy cattle better adapted to subtropical climates has been to discover some easily measured morphological or physiological characteristic that could be used as an index of the animal's heat tolerance. The object of this study is to present the results of an attempt to correlate certain readily measured blood constituent levels (hemoglobin, hematocrit, plasma calcium, and plasma inorganic phosphorus) with heat tolerance.

Rusoff *et al.* (*1*) reported that higher hemoglobin, hematocrit, and plasma inorganic phosphorus levels exist in the blood of Sindhi-Jersey daughters than in their Jersey dams. Similarly, Blincoe *et al.* (*2*) re-

Table 1. Mean blood constituent levels of the breed groups before (period I), immedately after (period II), and 18 hr after exposure (period III) to a standardized hot environment of 105°F and 34 mm-Hg vapor pressure.

Breed group	Period I	S.E.*	Period II	S.E.	Period III	S.E.
			Hemoglobin (%)			
3/4 S, 1/4 J†	10.00	0.23	9.91	0.37	10.55	0.47
1/2 S, 1/2 J (F_1)	10.95	0.27	11.12	0.31	11.26	0.39
1/2 S, 1/2 J (F_2)	10.79	0.27	11.54	0.45	11.98	0.44
1/4 S, 3/4 J	10.50	0.30	10.84	0.27	11.21	0.21
J	10.00	0.24	10.15	0.21	10.23	0.21
			Hematocrit value (%)			
3/4 S, 1/4 J	36.86	1.37	37.32	1.60	38.77	1.73
1/2 S, 1/2 J (F_1)	36.79	1.27	37.00	1.60	38.36	1.56
1/2 S, 1/2 J (F_2)	38.57	1.51	39.43	2.28	41.60	4.01
1/4 S, 3/4 J	39.13	0.81	39.88	1.05	42.32	1.99
J	36.41	0.89	36.65	0.80	37.09	0.85
			Plasma Ca (mg %)			
3/4 S, 1/4 J	9.93	0.28	10.19	0.27	10.04	0.29
1/2 S, 1/2 J (F_1)	10.63	0.66	10.04	0.28	10.00	0.24
1/2 S, 1/2 J (F_2)	10.02	0.23	10.68	0.33	10.27	0.23
1/4 S, 3/4 J	10.12	0.18	10.44	0.15	10.29	0.16
J	10.49	0.21	10.62	0.27	10.24	0.19
			Plasma inorganic P (mg %)			
3/4 S, 1/4 J	6.34	0.35	6.47	0.28	7.24	0.29
1/2 S, 1/2 J (F_1)	4.61	0.36	4.36	0.40	4.87	0.23
1/2 S, 1/2 J (F_2)	5.36	0.16	5.64	0.26	5.59	0.33
1/4 S, 3/4 J	6.01	0.36	5.29	0.50	6.15	0.37
J	5.11	0.19	4.26	0.22	5.67	0.19

*Standard error of the mean. † S refers to Red Sindhi; J refers to Jersey.

ported higher hematocrit, hemoglobin, and erythrocyte values in Brahman (Indian evolved) than in Brown Swiss (European evolved) cattle. Since the Indian-evolved Zebu cattle and their offspring are reported to be more heat tolerant than the European breeds (*3*) it remained to be determined whether these or other blood constituents were in some way related to heat adaptability.

Twenty-six crossbred and 15 purebred Jersey heifers, 6 to 24 mo of age, were subjected to a standardized hot environment of 105°F dry-bulb temperature and 92°F wet-bulb temperature (34 mm-Hg vapor pressure) in a climatic chamber for a period of 6 hr at 2-mo intervals. Of the crossbreds, nine were ½ Sindhi, ½ Jersey (F_1); eight were ¾ Sindhi, ¼ Jersey; three were ½ Sindhi, ½ Jersey (F_2); and six were ¼ Sindhi, ¾ Jersey; the different types of crosses were treated as distinct groups in the subsequent analysis.

At each exposure test, three separate blood samples were obtained from each animal according to the following time schedule: (i) period I, 18 hr prior to subjection to high temperatures (to obtain a "normal" blood picture); (ii) period II, immediately after the 6-hr exposure period (to reflect the "short-term" physiological response of the animal to the high temperature); and (iii) period III, approximately 18 hr after the termination of exposure (to determine whether any "long-term" physiological responses, could be detected). This series of blood samples was obtained from each animal from one to three times during the year; blood constituent determinations were carried out according to techniques previously reported (*1*).

The average levels of the various blood constituents for the different breed crosses prior to (period I), immediately after (period II), and 18 hr after exposure (period III) to the standardized hot environment are shown in Table I (*4*). Within-breed, between-period differences in blood values were not significant (tested by means of *t*-tests; in most cases, *t* was less than 1.0).

From these results it appears that hemoglobin, hematocrit, plasma calcium, and plasma inorganic phosphorus levels are not appreciably altered by a 6-hr period of exposure to hot conditions; therefore, since levels of these blood constituents do not indicate a response to thermal stress, these measurements, as presently taken, could not serve as suitable indexes of heat tolerance.

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29 October 1954.

Viscoscity Studies on the Sodium Desoxyribonucleates Obtained from Pneumococcus Types III and VI

Virgil L. Koenig*

Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico

In order to gain more information about the molecular characteristics of the sodium desoxyribonucleates isolated from pneumococcus type III and pneumococcus type VI (*1, 2*), a series of viscosity studies was undertaken on each of these desoxyribonucleates (*3*). Since these substances do have the ability to transform under suitable conditions the R strain of pneumococcus into the capsulated type III pneumococcus in one case and the capsulated type VI pneumococcus in the other case, it would seem that more information concerning the molecular properties of these desoxyribonucleates is needed.

The method previously employed to estimate the molecular weight of thymus sodium desoxyribonucleate (*4*) was employed in these experiments to estimate the molecular weights of the desoxyribonucleates from pneumococcus type III and pneumococcus type VI. This method employs the sedimentation constant, the intrinsic viscosity, and the partial specific volume in suitable equations giving the molecular weight.

The desoxyribonucleates studied were those previously isolated (*1, 2*). Because of the small amount of material available, only the ordinary Ostwald laboratory viscometer with a flow time of 80 to 100 sec for water was used. The viscosity studies were carried out at 20° ± 0.1°C. Density determinations were made using the Ostwald pycnometer (*5*). The desoxyribonucleates were dissolved in 0.2*M* NaCl, placed in Visking casings, and put to dialyze against 0.2*M* NaCl at 5°C for 24 hr. Before viscosity determination, the solutions were filtered through a coarse sintered-glass filter to remove large particles. Each solution was diluted serially by weight, giving a series of six different concentrations each. The concentrations of the original solutions were determined as was previously described (*4*). The relative viscosities, η_r, were calculated. The regression lines for ln η_r on c were calculated by the method of least squares. These curves were analyzed statistically and interpreted. The slopes of these lines give the weight intrinsic viscosities. In each case the volume intrinsic viscosity was obtained by multiplying the weight intrinsic viscosity by 100 and dividing by the respective partial specific volume.

Table 1. Viscosity data at 20°C.

Desoxyribonucleate from pneumococcus type III*		Desoxyribonucleate from pneumococcus type VI†	
Concn. (g/100 ml)	$\ln\eta_r$	Concn. (g/100 ml)	$\ln\eta_r$
0.080	1.037	0.085	1.184
0.053	0.703	0.056	0.784
0.034	0.457	0.036	0.519
0.027	0.365	0.028	0.405
0.020	0.270	0.021	0.307
0.011	0.157	0.012	0.174

* $\ln\eta_r = 13.15c$; $\sigma = 0.20$; $r = 0.9992$; volume intrinsic viscosity = 13.15/0.515 × 100 = 2553.4.

† $\ln\eta_r = 14.06c$; $\sigma = 0.18$; $r = 0.9994$; volume intrinsic viscosity = 14.06/0.568 × 100 = 2475.4.

The results of the viscosity determinations are given in Table 1. The standard errors of the slopes, σ, are given and the correlation coefficients, r, for the lines are given. The volume intrinsic viscosities are also listed in the table.

Values for the axial ratio, frictional ratio, molecular weight, and molecular dimensions were calculated for both of the desoxyribonucleates using the equations of Simha, Perrin, and Svedberg (*6*) for prolate ellipsoids of revolution. For sodium desoxyribonucleate from pneumococcus type III using a volume intrinsic viscosity of 2553.4, sedimentation constant of 13.37 (*1*), and partial specific volume of 0.515 (*1*), the following values were obtained: axial ratio, 222.56; molecular weight, 1,200,000; molecular diameter, 1.80 mμ; and molecular length, 399.14 mμ. For sodium desoxyribonucleate from pneumococcus type VI using a volume intrinsic viscosity of 2475.4, sedimentation constant of 17.10 (*2*), and partial specific volume of 0.568 (*2*), the following values were obtained: axial ratio, 219.06; molecular weight, 2,100,000; molecular diameter, 2.26 mμ; and molecular length, 495.08 mμ.

Considering the desoxyribonucleates as flexible chain molecules, one obtains, by making the indicated substitutions in the Mandelkern and Flory equation (*7*), the following values of molecular weight: for desoxyribonucleate from pneumococcus type III, 1,900,000; and for desoxyribonucleate from pneumococcus type VI, 3,400,000.

The weight intrinsic viscosity of the sodium desoxyribonucleate from pneumococcus type VI is significantly higher than that of the sodium desoxyribonucleate obtained from pneumococcus type III. On the other hand, because of the effect of the partial specific volume, the volume intrinsic viscosities are less different. When the necessary physical data are substituted in appropriate equations, the molecular weight of the desoxyribonucleate from pneumococcus type VI is significantly higher than that of the desoxyribonucleate from pneumococcus type III. Both of these desoxyribonucleates have transforming activity, in that they can transform the R strain of pneumococcus into the capsulated pneumococcus type III or the capsulated pneumococcus type VI. Although it is probable that more remains unknown than is known about the transforming process, it is interesting to conjecture that part of this difference in transforming specificities is the result of differences in molecular size. In any event, these molecules are large and show a high degree of asymmetry.

Differences in molecular weight are observed when one assumes that the desoxyribonucleates are a prolate

ellipsoid of revolution or a flexible chain molecule. More work probably will have to be done before an ideal model can be designed. It is felt that the differences in observed viscosity values for the two desoxyribonucleates are real. The viscosity values are not considered to be absolute, because insufficient material was available for an investigation of the effect of shear gradient.

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* Present address: VA Research Hospital, 333 E. Huron, Chicago 11, Ill.
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20 December 1954.

Reversible Photoreaction Controlling Expansion of Etiolated Bean-Leaf Disks

James L. Liverman,* Mary P. Johnson, Lawrence Starr†

Kerckhoff Laboratories of Biology, California Institute of Technology, Pasadena

Several developmental responses of higher plants are known to be controlled by the same or a quite similar reversible photoreaction. Thus lettuce seed germination (*1*), cuticle coloration of tomato (*2*), photoperiodic induction (*3*), and auxin-induced growth of the oat coleoptile (*4*) are all dependent on reactions either promoted or inhibited by red light (6500 A). These red-light-induced reactions, whether promotive or inhibitory, are all reversed by subsequent exposure to far-red irradiation (7350 A). The expansion of etiolated leaves is also known to be light-dependent, with red light being maximally effective in promoting the expansion (*5*). The experimental results reported here (*6*) are the first demonstration that this red-light-promoted expansion is reversed by subsequent exposure to far-red irradiation.

Seed of Ferry-Morse dwarf stringless greenpod beans that had been sterilized in 15-percent Purex were thoroughly washed in distilled water, soaked for 3 hr, and then grown in a sand-vermiculite mixture kept in a darkroom maintained at 26° ± 1°C. Disks, 5 mm in diameter, were prepared from the unexpanded simple leaves of these dark-grown beans according to the method of Miller (*7*). The leaf sections were then placed in petri dishes on filter-paper disks treated with 5 ml of solution at *p*H 5.6 containing 3 percent D-glucose, by weight, and 0.08*M* KNO_3. All manipulations prior to final measurement were performed under a dim green safelight (*4*). Durations of the red and far-red irradiations are indicated in Tables 1 and 2. All measurements were made after 48 hr with the aid of a binocular microscope equipped with an ocular micrometer.

The data of Table 1 show that red light (*4*) promotes expansion of etiolated bean-leaf disks and that this promotion is reversed by subsequent exposure to far-red irradiation (*4*). A comparison of treatments 5 and 6 of Table 1 shows that red light given continuously is more effective than a single short exposure. This is in agreement with Miller's finding (*8*) that an additional exposure to red light given on the second day of incubation causes a marked increase in expansion over that elicited by a single exposure.

The data of Table 2 summarize the results of a series of experiments in which red light alone, red light followed by far-red, or no irradiation were given to separate lots of leaf sections. These results are in agreement with those presented in Table 1. Downs

Table 1. Promotion of expansion of etiolated bean-leaf disks by red light and reversal of the red-light effect by far-red light. Results expressed as millimeters increase in diameter of 5-mm disks after 48-hr growth in darkness following exposure.

Treatment	Duration of treatment (hr)	Increase in diameter
1) Red (fluorescent source and filter)	0.5	1.7 ± 0.04*
2) Same as No. 1, followed by far red	1	1.1 ± 0.02
3) Red (Mazda and filter)	0.5	1.6 ± 0.03
4) Same as No. 3, followed by far red	1	1.0 ± 0.03
5) Red (photographic safelight, 60 w)	0.5	1.5 ± 0.04
6) Same as No. 5, given continuously	48	2.0 ± 0.02
7) Far-red control	1	0.9 ± 0.02
8) Dark control	48	1.0 ± 0.02

* Standard error.

Table 2. Suppression of the red-light-promoted bean-leaf disk expansion by far-red exposure. Results expressed as millimeters increase in diameter of 5-mm disks after 48 hr.

Experiment no. and conditions	Expansion in		
	Red	Red followed by far red	Dark
L-3 17.5-hr irradiation	2.6		1.2
L-8 20 min red, 40 min far red	1.53	1.19	1.01
	1.62	1.08	1.04
L-10 30 min red, 45 min far red	1.86	1.13	1.05
Average of L-8 and L-10	1.67	1.13	1.03

(*9*) has confirmed these results and has shown in detail that the action spectrum for controlling the expansion of etiolated leaves on intact bean plants is identical to that for the other afore-mentioned morphological responses.

These results, then, add another morphological response to the ever-increasing list of responses that appear to be controlled through some primary photoreaction. However, one can only conjecture about the nature of the reactions that follow this primary light reaction and that eventually lead to the manifestation of the various responses.

References and Notes

* Present address: Department of Biochemistry and Nutrition, Texas Agricultural Experiment Station, College Station.

† Present address: Department of Food Technology, Massachusetts Institute of Technology, Cambridge.

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7 December 1954.

Communications

Prior Publication

This laboratory recently reported the production of cellotetraose during enzymatic hydrolysis of cellulose [*Science* **120**, 1033 (1954)]. Through *Chemical Abstracts* [**48**, 13746^h, (1954] we later became aware of related work by Kooiman *et al.* in a journal not available on this campus [*Enzymologia* **16**, 237 (1953)]. Since the abstract did not indicate that either the tetraose or other intermediate dextrins had been observed, we did not cite the Dutch paper.

When a reprint arrived from Kooiman, however, it became obvious that the tetraose and several other dextrins had been recognized. Our report, then, must be viewed as simply corroborating Kooiman's excellent initial observation. We have written to Kooiman apologizing for our error and would like to correct immediately the erroneous statement in our report that intermediate dextrins had not previously been observed in enzymatic cellulose hydrolysates.

JOHN H. HASH

Biology Department, Virginia Polytechnic Institute, Blacksburg

KENDALL W. KING

Department of Biochemistry and Nutrition, Virginia Agricultural Experiment Station, Blacksburg

10 February 1955.

Spectral Absorption of Turbid Systems Using Diffuse Light

For a long time, absorption spectroscopy has found successful and even spectacular application to the measurement of the chemical composition and reaction kinetics of living cells. The effects of the turbidity of biological materials, which if ignored can lead to quantitative errors and even to qualitatively fallacious conclusions, have been widely realized in these researches, and artifices have usually been introduced in order to reduce turbidity, or to include much of the scattered light in the transmitted beam, or to insure that important changes of turbidity do not occur during the course of the reaction under investigation. Nevertheless, a method of general applicability has not emerged. In this paper we refer to preliminary experiments which suggest that such a general solution to the problem might be possible.

It is convenient to introduce the subject by referring to recent experiments by Burk (*1*) and Warburg and Krippahl (*2*), although our work was done without knowledge of theirs. In their experiments the vessel containing a turbid colored cell suspension was surrounded by a large spherical diffuse reflector. A measurement of the amount of light not absorbed by the cells when exposed to an incident monochromatic beam was obtained by measuring the light intensity at some point on the periphery of the globe, taking advantage of the fact (*3*) that the intensity at the wall of a diffusing sphere containing a source of radiation (the cell suspension in this case) is the same at all points even when the source does not emit equally in all directions.

In the other experiments (*1, 2*) the turbid absorber occupied only a very small fraction of the volume of the diffusing globe, so that the effect of double or multiple passage of diffusely reflected radiation through the absorber resulted in only a small correction term. In our own work the absorbers filled the globe, so that the process of diffuse reflection which gives the globe its essential "integrating" character for scattered radiation also has the effect of exaggerating the absorbing properties of the contents in a manner that may be expressed by comparing a globe of diameter d to a conventional absorption cell of thickness nd, where n is often much greater than unity.

The absorbing sphere with diffusely reflecting walls ("diffuse light absorption vessel," DLAV) was real-

ized very simply in the laboratory. A round-bottom fused quartz flask (about 60 cc) was imbedded in magnesium oxide powder; two small holes were left for admitting monochromatic light and for viewing the interior with a 1P21 photomultiplier tube.

A few very simple experiments served to establish the essential properties of the device. (i) When the flask contained a pure absorber (dilute aqueous $KMnO_4$), the response of the phototube as a function of wavelength I, compared with that obtained with pure water I_w, had the maxima and minima characteristics of the $KMnO_4$ absorption. The number n, representing the effective path length, was a function of the extinction, and was of the order of magnitude 10. (ii) With a colorless turbid material (Dow polystyrene latex), the relative phototube response I/I_0 was not very different from unity and decreased only threefold for a 10^{15}-fold decrease of transmission in a conventional absorption cell. (iii) Mixtures of Dow polystyrene latex and hemoglobin gave the same absorption curve as pure hemoglobin. (iv) Suspensions of intact red blood cells, that gave a very flat wavelength response in the Beckman spectrophotometer were qualitatively indistinguishable from the laked cells when they were observed in the diffuse-light absorption vessel; close quantitative agreement was obtained, except for relatively small differences, which require further investigation. (v) Measurements on a suspension of bacterial cells (*Escherichia coli*) in the presence and absence of free oxygen gave good spectra of the bacterial cytochrome system, particularly of the powerful Soret band at about 420 mμ; this band was completely masked in the Beckman absorption curve. (vi) A clear red colloidal gold gave the same absorption spectrum in the diffuse-light absorption vessel as in the Beckman cell, with a maximum at about 520 mμ. Increasing the average particle size by addition of sodium chloride made the sol turn blue, with a strong Tyndall sheen, and caused the apparent absorption observed in the Beckman cell to be displaced to some wavelength beyond 600 mμ. The maximum observed in the diffuse-light absorption vessel remained between 540 and 580 mμ, at wavelengths that appeared to shift somewhat with the sol concentration.

The foregoing experiments deal with several examples of spectral absorption associated with light scattering, including, at the one extreme, the case of an optically "clear" absorber associated with colorless scattering elements and, at the other extreme, a colloidal suspension of particles that themselves absorb strongly. The results of these experiments give some indication of the scope and limitations of the new method. It has proved reliable, at least as far as first-order effects are concerned, in determining the spectral absorption of a continuous phase that separates nonabsorbing scattering particles and the spectral absorption of a continuous phase (concentrated hemoglobin solution) enclosed within a scattering envelope.

The method has also made it possible to observe the same spectral absorption of bacterial cells and the same changes associated with removal of molecular oxygen as those already demonstrated in more elaborate researches (*4*). It shares with these researches the limitation that the absorbing material in the bacterial cell is not necessarily manifested in its totality; in the new method, as in others, the absorbing material either may be opaque or may be shielded by scattering components.

The nature of the association between absorbing and scattering structures in living cells is undoubtedly complex; even when all scattered light is collected, the contributions of different substances to the total absorption may depend not only on their quantity but also on their location within the cell. We presume that the observations on a polydisperse colloidal gold illustrate how complex the situation may become when scattering and absorption are interdependent and when the absorption index is so high that at least some of the particles in the system are opaque.

J. B. Bateman
G. W. Monk

Camp Detrick, Frederick, Maryland

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27 December 1954.

Nutritional Changes in Diets Exposed to Ethylene Oxide

Ethylene oxide has been employed as an insecticide and bactericide for many years. It has been used in the food industry (*1*), and recent publicity (*2*) suggests that it may be a suitable sterilizing agent for a variety of products. This paper presents evidence that when diets are treated with ethylene oxide the nutritional properties are impaired.

The animals were female rats of the Osborne and Mendel strain. Except as otherwise noted, litter-mate controls were used and group mean starting weights were within the 38- to 40-g range. Each animal was housed individually on wide-mesh wire screen and given free access to food and water. The purified diet contained (in percentages) Labco casein 20, sucrose 69, Wesson oil 5 (*3*), Wesson salts 4 (*4*), and a vitamin mixture 2 (*5*). The stock diet was ground dog meal pellets (*6*).

For treatment with ethylene oxide, 500 g of diet was spread on large Petri dishes to a depth of 1 cm or less. The dishes were then stacked in a 10-lit desiccator (without desiccant). A small vent at the top prevented pressure accumulation and glass rods between the dishes assured free access of the gas to the diets. Ten milliliters (8.84 g) of liquid ethylene oxide

Table 1. Weight changes of rats fed diets exposed to ethylene oxide. The numbers in parentheses show number of rats dead at indicated time.

Diet	Exposure time (hr)	No. of rats	Weight gain (g) and standard error* at day			
			2	14	28	56
Purified	0	10	7 ± 1	64 ± 1	120 ± 3	
Purified	18	10	1 ± 1	22 ± 1	8 ± 2	
Stock	0	10	8 ± 1	63 ± 2	123 ± 4	172 ± 8
Stock	6	5	2 ± 1	41 ± 5 (1)	79 ± 8 (1)	120 ± 10 (1)
Stock	12	5	−2 ± 1	28 ± 3	62 ± 3	117 ± 7 (1)
Stock	18	5	−7 ± 1	5 ± 1	34 ± 3	86 ± 5
Stock	24	10	−6 ± 1	2 ± 3 (3)	15 ± 6 (3)	57 ± 10 (5)

* Standard errors determined by method of N. Mantel, *Am. Stat.* 5, 26 (1951).

(cold) was introduced, and the lid was rapidly replaced. After standing for the specified length of time at room temperature, the Petri dishes were removed and exposed to air overnight to dissipate residual gas before the diet was stored in metal cans. As an added precaution, some batches were subjected to a vacuum (pressure about 20 mm-Hg) for two 20-min periods with an intervening admission of air. This practice was discontinued when no difference was found in the growth response of rats fed the evacuated and non-evacuated diets.

The results summarized in Table 1 indicate severe damage to both purified and stock diets, but the effects produced by feeding the two differed in important respects. Growth was impaired after 2 days on the purified diet that had been treated for 18 hr. Thereafter the animals grew slowly for about 2 wk and then lost weight until they died in about 3 more weeks. The initial effect was more severe in the case of the 12-, 18-, and 24-hr treated stock diets. By the end of the first week 14 of the 20 animals had started to gain slowly and were still growing after 8 wk.

The deleterious effect of the purified diet treated with ethylene oxide was also seen in approximately 10-wk old animals (7) that had been fed the untreated diet since weaning. When these older rats were placed on the diet treated for 18 hr, they continued to grow for 7 to 10 days and then started losing weight, with the first death occurring 5 wk later. Food consumption was essentially unchanged for the first 2 days and thereafter declined to about 25 percent of the original intake. Animals that died on this regime had completely depleted their visible fat stores. Animals raised on the stock diet for approximately 7 wk and then changed to the stock diet treated in a similar manner with ethylene oxide immediately lowered their food consumption to about 70 percent of their original intake. Their body weights leveled off at that point.

That the treated purified diet might be deficient in thiamine was suggested by the fact that growth failure started at 2 wk and death followed 3 wk later. Analyses of this diet by the thiochrome method indicated that the thiamine was almost completely destroyed. Animals that had lost considerable weight on this diet gained an average of 38 g during the first week of oral supplementation with thiamine. Supplements of a complete vitamin mixture produced essentially the same results.

Thiamine hydrochloride dispersed in starch treated with ethylene oxide in the afore-mentioned manner retained its full activity. However, it was destroyed by similar treatment in the presence of choline chloride but not in the presence of choline dihydrogen citrate. When the starch mixture containing choline chloride was treated with ethylene oxide and then mixed with water, the resulting suspension was quite alkaline. This was not the case when choline dihydrogen citrate was substituted for the chloride. These findings indicate that the ethylene oxide does not react directly with thiamine. A partial answer to the mechanism whereby thiamine is destroyed may be the alkalinity produced under ethylene oxide treatment when choline chloride is added to the thiamine starch mixture.

A number of observations suggest that thiamine is not the only factor that is affected by ethylene oxide. Rats fed the treated purified diet with added untreated thiamine exhibited the initial growth inhibition. Thereafter they gained an average of 16 to 18 g/wk for 4 wk compared with an average of 30 g/wk for the controls on the untreated diet. At that time they appeared stunted but in reasonably good condition, whereas rats on the treated diet without thiamine were losing weight and were obviously near death. In addition, feeding an ethylene-oxide treated thiamine-deficient purified diet produced the initial growth inhibition, whereas the same diet without ethylene oxide treatment allowed continuous growth for the first 10 days. Thus far supplementation with thiamine or a complete vitamin mixture has not significantly stimulated growth of rats fed the treated stock diet.

It should be noted that the conditions that we employed in treating diets with ethylene oxide are comparable to some of those proposed for commercial use (*1*). The effectiveness of ethylene oxide in sterilizing our diets was tested with *B. globigii* spores (*8*). When diets were seeded with these spores, viable organisms could be recovered after 18-hr exposure to

ethylene oxide. Although all of the organisms were not destroyed by this treatment, there was a marked reduction in the count.

We wish to emphasize that we have not determined the effects of ethylene oxide on foods intended for human consumption or on practical animal foods other than our stock diet. Processing frequently is detrimental to the nutritional qualities of foods, and desirable changes must be weighed against the damage done. Nevertheless, in view of the afore-described results, it is suggested that foodstuffs, particularly those that may be major sources of essential nutrients, should not be subjected to ethylene oxide treatment until its effects have been established.

EDGAR A. HAWK*
OLAF MICKELSEN

Laboratory of Biochemistry and Nutrition
National Institutes of Health, Bethesda, Maryland

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4. Salt mixture W, obtained from Nutritional Biochemicals Corp., Cleveland, Ohio.
5. Containing the following in milligrams per 100 g finished diet: thiamine HCl 0.4, riboflavin 0.6, pyridoxine HCl 0.5, nicotinic acid 4.0, Ca pantothenate 4.0, folic acid 0.2, biotin 0.02, choline chloride 200, inositol 20, and menadione 0.2 in cornstarch. Vitamin B_{12} (0.02 mg) was added separately as a water-alcohol solution.
6. Hunt Club dog meal, manufactured by Animal Foundation, Inc., Sherburne, N.Y.
7. These animals were divided into groups having comparable average weights when the treated diet was started.
8. The *B. globigii* spores were supplied through the courtesy of Charles R. Phillips and Saul Kaye, Camp Detrick, Frederick, Md. We also wish to acknowledge the valuable technical assistance of Ruth Clary and Samuel M. Takahashi.

* Present address: Medical Department, Upjohn Company, Kalamazoo, Mich.

23 November 1954.

On "Improving Scientific Communication"

It is refreshing to read the clear description that S. M. Garn [*Science* **121**, 7A (21 Jan. 1955)] has given of the diversification in requirements, specifications, and style in the imposing forest of scientific journals. The problem has been in existence a long time. It has been aggravated by the rapid increase in the number of journals in print. Authors have been unduly put upon to adhere to often silly differences among journals. Industrial and government laboratories have found it expedient to maintain files of journal specifications and assign personnel to become familiar with the journal idiosynerasies. Academic authors must rewrite and check style mechanics with copies of a given journal before submitting an article for publication. Publication of valid research is in jeopardy unless these details are scrupulously adhered to in writing.

I urge that AAAS implement the wise suggestion made by Garn. A small steering committee should outline the items of confusion and invite 10 or 20 editors from the journals of largest circulation to study the problem and meet in plenary session to establish unanimity among the many mechanical impediments to manuscript preparation. Perhaps several of the larger trade journals should be included.

With such problems out of the way, authors, editors, and reviewers could devote increased attention to the more difficult problems of clarity and conciseness of expression, accuracy and originality of presentation.

W. H. WALDO

Kirkwood, Missouri

3 February 1955.

Science and Poetry

I have read with great interest the excellent editorial entitled "Science and poetry" and also several stimulating communications on the same subject [*Science* **120**, 17A and 951 (3 Dec. 1954)].

I was delighted to find that Phyllis McGinley was cited as holding the threads of the matter in the palm of her hand. I think she does. Of all her *Love Letters*, her "In praise of diversity" (which Louis Untermeyer, in the *Atlantic Monthly* for December, correctly called an "essay") seems most relevant to the point of issue.

I suggest that no discussion of this subject would be complete without reference to James B. Conant's Franklin Medal lecture of 19 Nov. 1943 before the American Philosophical Society on the general subject "The advancement of learning in the United States in the post-war world" [*Proc. Am. Phil. Soc.* **87**, 291 (1944)]. Among other things, Conant had this to say:

> Let me now turn from the first category—accumulative knowledge—to the other two which, following Bacon closely, I shall designate as poesy or, if you prefer, poetry and philosophy. Whereas the idea of progress is both valid and significant in the first category, accumulative knowledge, in the other two the concept is not only invalid but a positive deterrent to relevant undertakings. And at this point, lest all but scientists, mathematicians, and archaeologists leave the room in protest, I hasten to assert that I place no halo over the word progress. There is no hierarchy implied in my classification.
>
> Indeed, anyone who wished to give poetry or philosophy an inferior place as compared to accumulative knowledge would soon find himself in an untenable position. For it is obvious that poesy or poetry on the one hand and philosophy on the other together hold the keys to man's immediate future, including the future of the advance of accumulative knowledge. That this is so, current history provides ample proof. Nazism triumphed in Germany not because the Germans were lacking in power to advance learning but because bad poetry and a wrong philosophy prevailed. . . .
>
> One of the chief ends of education is surely to develop the capacity for making civilized judgments on all those matters of value which are involved in so many vital human decisions. Such judgments can be

illuminated often by our knowledge of the past experiences of the race, but they are largely determined by emotional reactions and channels of thought whose pattern by necessity varies from age to age. It is thus the poetry and philosophy of the present, rather than accumulative knowledge, which play the significant role in outlining the next act in the drama of world history.

ROBERT GOTTSCHALK
Standard Oil Company (Indiana),
910 South Michigan Avenue, Chicago, Illinois

14 December 1954.

Q_{10} of the Maximum Tetanic Tension Developed by Isolated Muscle Fibers of the Frog

The experiments (*1*) reported here are essentially confirmatory in nature to those previously analyzed by Bull (*2*). Therefore no review of the extensive literature on the Q_{10} of the maximum developed tetanic tension of muscle will be undertaken.

The technique of isolation, recording, and measurement was the same as that previously described (*3*), except that the stimulator was a Harvard inductorium. The electrodes were two chlorided silver wires each placed one-third of the length of the fiber from each end. The length at which the fiber developed maximum tetanic tension was determined at some particular temperature, and the fiber was stimulated at this length subsequently. The lever was not calibrated for absolute tension. No particular rule was followed in the order of the variation of temperature, but in all instances a complete cycle was carried out; an experiment was rejected if the fiber did not develop approximately the same tension on return to its original starting temperature. The temperatures were changed gradually and the range was limited from 0° to 25°C. Very few experiments were performed at temperatures above 22°C because in many fibers the tetanus was incomplete at higher temperatures.

The results were quite variable. Earlier (*1*) it was noted that when a fiber shortened unevenly it developed more tension than it did when it shortened evenly along its length, but that if stimulation was continued long enough any unevenness became distributed and the tension fell to a value characteristic of the evenly shortened fiber. In order to maintain a tetanus long enough for this to occur the stimulus frequency must be carefully adjusted for each temperature. In particular, the frequency of stimulation for a maintained tetanus at very low temperatures must be very low indeed. The tetanus cuts off quickly at low temperatures if the fiber is stimulated by a Harvard inductorium (*5*). The variable frequency stimulators available to us at the time did not have sufficient power output to compensate for the Ringer solution shunt unless the electrodes were dangerously near the fiber. In theory, multiple cathodes should minimize any unequal shortening, but in practice this has a negligible effect as contrasted with alternating cathodes placed as described in the previous paragraph for single muscle fibers, because the majority are so uneven in cross section along their length. A further contributing factor to the variability in the results must have been the alteration in conduction velocity with temperature (*6*).

Table 1. Data illustrating the variability in two typical experiments.

Expt.	Temp. (°C)	Tension (arbitrary units)	Time (min)
3	16.5	97.8	0
	16.5	100.0	15
	16.5	100.0	20
	7.8	91.1	58
	7.8	91.1	85
	17.0	96.8	110
	21.3	98.0	130
	10.0	88.7	155
	16.8	94.5	175
4	10	90.3	0
	18	97.2	17
	17	97.2	49
	17.7	100	55
	10	91.7	164
	10	94.4	180
	25	97.2	227

Table 1 illustrates the variability in two experiments that were accepted as satisfactory. In both of these the tension tended to be low at the low temperatures, but in others it was high. In each of the eight experiments accepted as satisfactory out of the 25 done, the maximum tension was plotted against the temperature in degrees Celsius, and the best straight line through the points was determined by the method of least squares. The Q_{10} was then determined from the slope of this line. In Table 2 a is the intercept of the line, b the slope, and Pa and Pb the probable error of the intercept and slope, respectively. It will be noted that the probable error of the slope b is of the same order of magnitude as the slope itself. It is therefore likely that within the limits of experi-

Table 2. Q_{10}'s of the maximum developed tetanic tension of eight single muscle fibers with the constants and the probable errors of the least square lines from which they were calculated.

Expt.	Intercept a	Slope b	Probable error		Q_{10}
			Pa	Pb	
3	89.7	+0.34	3.21	0.21	1.038
4	90.6	+0.31	2.27	0.14	1.033
5	78.5	+0.78	1.98	0.13	1.100
6	74.8	+0.73	3.74	0.20	1.098
12	82.3	+0.53	4.12	0.22	1.063
13	91.0	−0.34	8.77	0.49	0.963
14	80.6	+0.66	14.2	0.86	1.080
15	81.8	+0.84	10.5	0.36	1.103

mental error the maximum tetanic tension developed by a single muscle fiber is the same at all temperatures between 4°C and 22°C.

MARY ANN WASHINGTON
MARY FRANCES ARRIGHI
SIBYL F. STREET
ROBERT W. RAMSEY

Department of Physiology,
Medical College of Virginia, Richmond

References and Note

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17 December 1954.

Marking of Shrimp

Interest has been shown by the U.S. Fish and Wildlife Service in sponsoring research to find a means to tag shrimp effectively for growth, migration studies, and definition of stocks. According to the proposal the tags should fulfill these conditions:

> . . . (*a*) will not impede the natural movements of the shrimp, (*b*) will not cause abrasion, lesions in, or otherwise damage any tissue of the shrimp, (*c*) will offer minimum opportunity for the entry of parasitic fungi or other pathogens into the tissues of the shrimp, (*d*) will not attract predators, (*e*) will persist throughout the life of the shrimp regardless of age at which mark or tag is imposed or attached, (*f*) can be easily detected and identified by untrained workers in the fishery, both ashore and at sea.

Some preliminary investigations of the usefulness of vital staining for this purpose were made at the Marine Laboratory of the Oceanographic Institute, Florida State University, during October 1954. The shrimp (*Penaeus setiferus*) were captured in Alligator Harbor and the adjacent Gulf of Mexico with a shrimp try net and a minnow seine. They were transported to outside tanks, 10 ft in diameter, supplied with running seawater. The shrimp were fed at infrequent intervals with bits of shrimp, fish, and crabs. A 2-ml insulin-type syringe with a No. 25 needle ½ in. in length was used. Several different colored inks and stains prepared for histological purposes were used in the preliminary experiments. The injections were made by piercing the shell in the posterior abdominal segment. Except when almost immediate death occurred, the stain spread throughout the animal almost instantaneously, presumably via the blood vascular system.

The majority of the stains killed the animals, either immediately or within several hours. Neutral red and methyl blue did not kill the shrimp but, because of the temporary nature of the coloring, were not considered satisfactory. With these two stains, color could be detected only in the branchial chamber after a few hours (concentrated in the gills) and had disappeared altogether within 24 hr. Fast green was very successful. Less than 5 percent mortality was experienced if the animals were handled carefully and not too much stain was injected. It was estimated that about 0.2 ml of the solution was injected into the animal, and the color was still plainly visible after a period of more than 60 days. Mortality was about the same (about 15 percent) in the injected animals as in the controls kept in the same tank. The majority of the animals shed at least once. After shedding, the stain became concentrated in the branchial area but was still very noticeable, especially when contrasted with the control.

These preliminary data satisfy conditions *a*, *c*, and *f*. Condition *b*, "will not cause abrasions, lesions in or otherwise damage any tissue of the shrimp," is not fulfilled, although it is thought that the damage to the tissue was slight, certainly less than that caused by attachment of a metal or plastic tag. It will not be known whether condition *d*, "will not attract predators," is fulfilled until controlled experiments are performed with marked and unmarked shrimp. It is not yet known whether the color will persist throughout life to fulfill condition *e*.

These findings are reported with the thought that other workers who are interested in marking shrimp may profit by them. It is planned to continue the investigations in the spring when shrimp will again be locally available.

It is felt that if the stains are prepared carefully so that isotonic solutions are made and toxic substances are not used for carriers, this method of marking will prove effective. This method is certainly faster and more economical than tagging with metal or plastic and probably will cause less mortality. It has great possibilities if several contrasting colors can be found, both for marking in several localities in one year to study migration and also for the succeeding year. Because of the short life span of the shrimp the same colors could be used over again, at least within 2 yr.

One difficulty with this method is that individual records cannot be kept and hence, although it is valuable for migration studies, it will not be as suitable for growth studies. However, great numbers of shrimp could be marked in a very short period, and if only shrimp of a restricted size interval were marked with a single color, the growth under natural conditions could be determined when the shrimp were recaptured.

R. WINSTON MENZEL

Contribution No. 27, Oceanographic Institute,
Florida State University, Tallahassee

16 December 1954.

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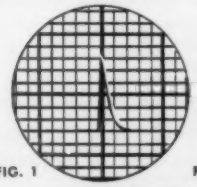

FIG. 1

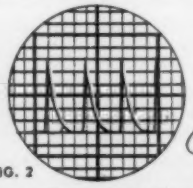

FIG. 2

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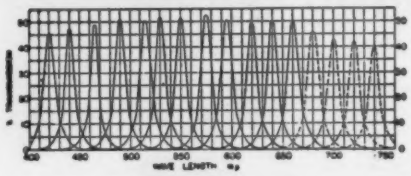

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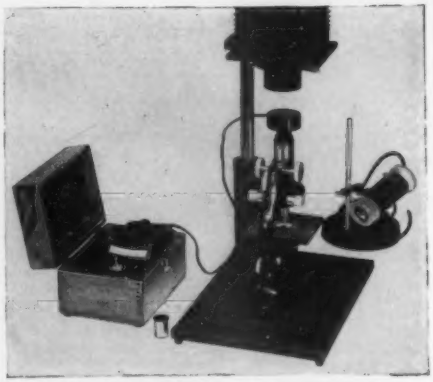

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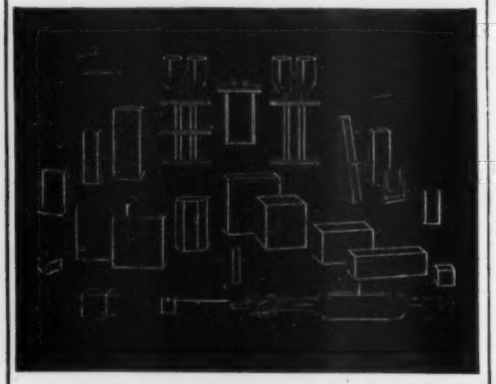

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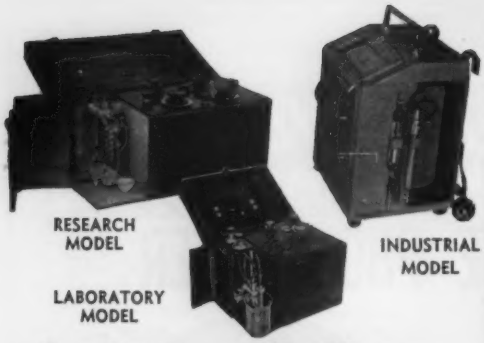

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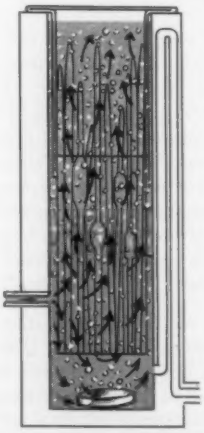

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Security Stirrings

FORMER Senator Cain has been making headlines by criticizing the current federal security program. After 2 years of experience as a member of the Subversive Activities Control Board, Cain has come to deplore a system that invites the use of hearsay, rumor, and association as a basis for branding a person as a security risk. He asks for the better selection of security officers, consideration of the nature of a particular job in weighing security requirements, revision of the present criterions of security, greater independence on the part of hearing boards, and a change from the current negative regulation that the employment of a person must be "clearly consistent" with national interest to the point of view that no person should be dismissed unless his employment is found to be "reasonably inconsistent with the national interest."

Cain's recommendations deserve special consideration because of his position and because of his history of right-wing conservatism. For similar reasons, the criticisms of Martin Dies have gained attention.

Several proposals for change or study have been made. The Senate has voted $125,000 to the Post Office and Civil Service Committee for an investigation of the current security-risk program. The study has the support of chairman Olin D. Johnson (D., S.C.) and former chairman Frank Carlson (R., Kan.). Senator Johnson announced that the State Department had informed him that not one of the employees who had been named in the highly publicized 1950 charges of the junior senator from Wisconsin had been found to be "a Communist or disloyal to our Government."

Senators Humphrey (D., Minn.) and Stennis (D., Miss.) introduced a joint resolution calling for a bipartisan 12-member commission to conduct "a careful reappraisal of our entire security system." Members would be drawn from official and civilian life. Representative Frelinghuysen (R., N.J.) introduced a companion resolution in the House. Representative Tumulty (D., N.J.) has proposed the creation of a special court for security cases.

Although there is not yet agreement upon a solution, some of the most reasonable and respected members of the Congress—on both sides of the political aisle—agree that improvement is necessary and that security measures must be removed from the kind of political charges and countercharges that marked the 1954 campaign.

From nongovernmental sources have come other evidences of desire for change. Freedom House, Inc., an educational and civic association working to strengthen democracy, has recommended a Presidential Commission on Security to determine whether current policies and practices carry "the risk of losing our lead in science and technology which freedom of inquiry has given us." The Fund for the Republic has made several grants for studies bearing on problems of security and civil liberties. One grant was to the Association of the Bar of the City of New York.

One of the most significant features of the current stirring is its diverse origin. Republicans and Democrats, liberals and conservatives, members of the Congress and private citizens are all among those calling for serious reappraisal of security methods. Perhaps 1955, with no election in the offing, offers the best opportunity for a calm and reasonable approach that we have had since the problem assumed its present magnitude. Certainly the question will undergo Congressional investigation and public debate; both those who are satisfied with things as they are and those who hope for change will have opportunities to express their views—D.W.

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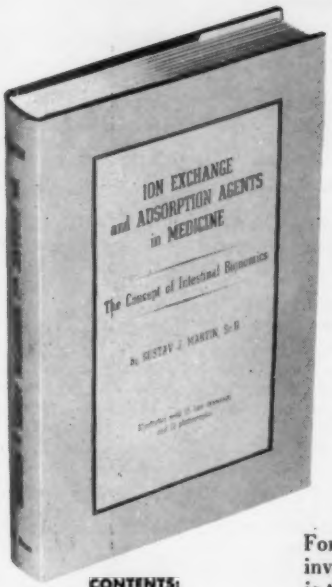

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University of New Mexico, Albuquerque, New Mexico, April 26-29

Southwestern Field Trip, Albuquerque-El Paso and return, April 30-May 1

Featuring a **Symposium on What is the Future of Arid Lands?** Public evening lectures, April 26, 27 and 28 by Homer L. Shantz, Charles E. Kellogg, and B. T. Dickson (Australia), and Technical Sessions:

Morning, April 27—Variability and Predictability of Water Supply in Arid Regions—Speakers: Reed W. Bailey, C. W. Thornthwaite, Jean Tixeront (Tunisia), Luna Leopold, F. Dixey (England), C. C. Wallén (Sweden), John H. Dorroh, T. L. Smiley.

Afternoon, April 27—Better Use of Present Resources—Speakers: Kanwar Sain (India), R. O. Whyte (Italy), L. N. McClellan, Hilgard O'R. Sternberg (Brazil), L. A. Richards, Cyril Luker, Raymond Price, Pedro Armillas (Mexico).

Morning, April 28—Prospects for Additional Water Sources—Speakers: E. J. Workman, Edward Bowen (Australia), Sheppard T. Powell, W. F. J. M. Krul (Holland), Vincent J. Shaefer, Glenn W. Brier, H. E. Hayward, Louis Koenig.

Afternoon, April 28—Better Adaptation of Plants and Animals to Arid Conditions—Speakers: Olaf S. Aamodt, Colonel Omar Draz (Egypt), R. Merton Love, Knut Schmidt-Nielsen, Enrique Beltrán (Mexico), B. P. Uvarov (England), Michael Evenari (Israel), L. M. Pultz.

Discussion Group Sessions, April 29 (See SCIENCE of February 11, 1955, or THE SCIENTIFIC MONTHLY of March, 1955, or write to the American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., U.S.A., for details. Cable Address: Advancesci, Washington, D. C.)

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Field Trip Reservation (limited to first 222 applicants—deadline **April 5**)
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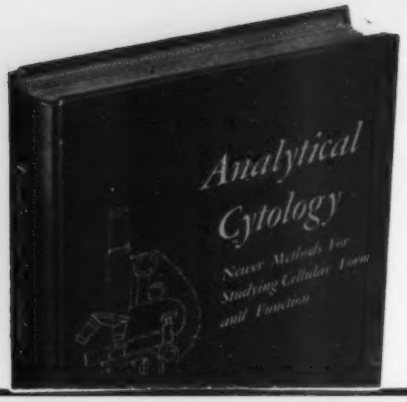

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Meetings & Conferences

April

25–26. American Soc. of Mechanical Engineers, Instruments and Regulators Conf., Ann Arbor, Mich. (C. E. Davies, ASME, 29 W. 39 St., New York 18, N.Y.)

25–27. Centennial Symposium on General Education, Basic College, Michigan State College, East Lansing. (P. H. Barrett, Dept. of Natural Science, Michigan State College, East Lansing.)

25–27. National Acad. of Sciences, 92nd annual, Washington, D.C. (Secretary, NAC, 2101 Constitution Ave., NW, Washington.)

25–27. Symposium on General Education, E. Lansing Mich. (Dept. of Information Services, Michigan State College, E. Lansing.)

25–30. International Symposium on Electrical Discharges in Gases, Delft, Netherlands. (A. W. van Wagensveld, Mijnbouwplein 11, Delft.)

26–28. American Industrial Hygiene Assoc., Buffalo, N.Y. (H. F. Smyth, Jr., 4400 5 Ave., Pittsburgh 13.)

26–29. International Health Cong., Bournemouth, England. (P. A. Wells, 90 Buckingham Palace Rd., London, S.W.1.)

26–1. International Symposium on Arid Land Problems, Albuquerque, N.M. *2–4* May. Conference (by invitation only), Socorro, N.M. (J. A. Behnke, 1515 Massachusetts Ave., NW, Washington 5, D.C.)

27–29. International Conference on Nuclear Engineering, Los Angeles, Calif. (T. J. Connolly, Dept. of Engineering, Univ. of California, Los Angeles 24.)

27–29. Soc. for Experimental Stress Analysis, Los Angeles, Calif. (W. M. Murray, Central Square Station, P.O. Box 168, Cambridge 39, Mass.)

28. West Virginia Academy of Science, Fairmont, W.Va. (James T. Handlan, Jr., Potomac State College, Keyser, W.Va.)

28–30. American Physical Soc. Washington, D.C. (K. K. Darrow, Columbia Univ., New York 27.)

28–30. Midwestern Psychological Assoc., Chicago, Ill. (L. J. Cronbach, 1007 S. Wright, Champaign, Ill.)

29–30. Alabama Acad. of Science, Tuscaloosa. (H. McCullough, Howard College, Birmingham, Ala.)

29–30. Colorado-Wyoming Acad. of Science, Greeley, Colo. (O. W. Olsen, Colorado A. & M. College, Fort Collins.)

29–30. Mississippi Acad. of Sciences, Meridian. (C. Q. Sheely, Box 574, State College, Miss.)

29–30. New England Radio-Electronics Meeting, Boston, Mass. (C. W. Metcalf, Inst. of Radio Engineers, 52 Chauncy St., Boston.)

29–30 Seismological Soc. of America, Berkeley, Calif. (G. D. Louderback, Bacon Hall, Univ. of California, Berkeley 4.)

29–30. Symposium on Fundamental and Applied Advances in Chelate Chemistry, sponsored by Polytechnic Inst. of Brooklyn, New York, N.Y. (H. P. Gregor, PIB, 85 Livingston St., Brooklyn 1, N.Y.)

30. American Mathematical Soc., Stanford University, Calif. (E. G. Begle, Dept. of Mathematics, Yale Univ., New Haven 11, Conn.)

30. New Hampshire Acad. of Science, Hanover, N.H. (H. W. Curtis, Thayer School, Dept. of Elec. Engineering, Dartmouth College, Hanover.)

30–5. American College of Apothecaries, Inc., Miami Beach, Fla. (R. E. Abrams, 2173 Knorr St., Philadelphia, Pa.)

(See issue of 18 March for more comprehensive listings.)

NEW BOOKS

Chemisorption

By B. M. W. TRAPNELL, Liverpool University

1955, 265 pp., $6.80

This work is designed to give a balanced presentation of the subject of chemisorption, in particular of discoveries made over the last fifteen years. The main part of the book, concerned with chemisorption itself, treats velocities of adsorption and desorption, equilibrium at surfaces, heats and mechanisms of adsorption, and the mobility of adsorbed layers. The two final chapters illustrate the relationship of chemisorption to heterogeneous catalysis and discuss the causes of catalytic specificity together with the mechanisms of some simple catalytic reactions. These include olefine hydrogenation and the cracking of hydrocarbons.

Acetylenic Compounds in Organic Synthesis

By R. A. RAPHAEL, Queen's University, Belfast

1955, 219 pp., $6.20

The rapid development of the chemistry of acetylenic compounds in recent years has led to an equally rapid increase in the number of their synthetic applications. The purpose of this book is to serve as a guide to the many techniques available, thus alleviating the hitherto necessary chore of literature search and pilot experiments. The techniques for synthesis are described from a practical viewpoint, with critical accounts of the best procedures and indications of their scope and limitations. For easy reference, the book is divided into sections corresponding to the main organic chemical types, i.e. aliphatic, conjugated, carbocyclic, and heterocyclic systems.

The Strengths of Chemical Bonds

By T. L. COTTRELL, Imperial Chemical Industries Ltd.

1954, 310 pp., $5.50

This new book presents a full description of the experimental approach to the study of bond strengths. Experimental methods for determining bond dissociation energies in diatomic and polyatomic molecules are discussed in detail, together with the methods of determining the heats of formation of molecules. Attention is chiefly given to the reliability and accuracy of the various methods and results. The numerical values of heats of atomization are listed and critically examined, and a table of internuclear distances and force constants is included for those bonds for which energetic information is available.

Electrolyte Solutions

By R. A. ROBINSON, University of Malaya and R. H. STOKES, University of Western Australia

1955, 524 pp., $9.50

A detailed account of the present state of knowledge of the most fundamental properties of electrolytes, conductance, chemical potential and diffusion, from the standpoint of the practical electrochemist. Modern experimental methods are discussed at some length, and extensive results are given, together with numerous tables useful in computations on electrolyte solutions.

The Structural Chemistry of Proteins

By H. D. SPRINGALL, University College of North Staffordshire

Foreword by LINUS PAULING, California Institute of Technology

1954, 376 pp., $6.80

This account of the structural chemistry of proteins is an up-to-date and detailed presentation of the work that so far has been done on their composition, chemical and physico-chemical properties, and molecular structure.

Mathematics for the Chemist:

Mathematical Analysis for Chemists, Physicists, and Chemical Engineers

By G. J. KYNCH, University College of North Wales

1955, 356 pp., $4.80

"*Mathematics for the Chemist*" will resolve a difficulty long familiar to scientists: that of deciding when a particular mathematical method can be applied to a problem, and when it cannot. Its purpose is to provide a text on the application of mathematics to the physical sciences, using the language of the chemist wherever possible.

Numerical Methods

By A. D. BOOTH, London University

1955, 204 pp., $6.00

The volume has been designed to give an understanding of the basic principles on which numerical analysis rests, and therefore approaches the subject from this aspect rather than giving instruction in the details of actual calculation. It is particularly directed to those who wish to acquire the art of programming for automatic calculators, for which a thorough knowledge of the underlying mathematical principles is essential, but where the actual details of calculation are carried out automatically.

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(a) Biochemist, M.S. or Ph.D.; 100-bed general hospital; attractive community; East. **(b) Bacteriologist;** by Board Pathologist, to supervise bacteriology departments in 2, possibly 3, hospitals; important university city. **(c) Microbiologist,** M.S. with interest in virology and experience in virus assays; noted pharmaceutical corporation. **(d) Biochemist,** Ph.D. as head of laboratory service, new diagnostic clinic now being organized; also research in enzyme and steroid chemistry; $8000; large city. Woodward Medical Personnel Bureau, 185 N. Wabash, Chicago. X

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Brown, V. E. "Synopsis of Medical Entomology"—$4.50; Reviews:—Acta Med. Scand. vol. 148, p. 493; Rivista di Parasit, vol. XV, No. 3, Rome; Medical Jour. of West Indies, 1954.

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AAAS SYMPOSIUM VOLUME

Sex in Microorganisms

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The genetic, physiological, and morphological evidence for "sex" in the principal groups of microorganisms—viruses, bacteria, fungi, unicellular algae, and protozoa—is presented by a group of experts in the field.

N. Visconti of the Carnegie Institution of Washington at Cold Spring Harbor, discusses recombination of "genes" in viruses. J. Lederberg of Wisconsin and E. L. Tatum of Stanford review genetic evidence for "sex" in bacteria, and W. G. Hutchinson of Pennsylvania and H. Stempen of Jefferson Medical College describe cell fusions in certain bacteria. J. R. Raper offers a comprehensive coverage of sex in fungi.

R. Patrick of the Academy of Natural Sciences, Philadelphia, describes syngamy in diatoms; R. A. Lewin of the Maritime Regional Laboratory, Halifax, the sexuality of other unicellular algae, especially the flagellates.

In two chapters D. H. Wenrich covers sexual phenomena in some of the protozoa and discusses the origin and evolution of sex, based primarily on the protozoa, but including material about all of the microorganisms. D. L. Nanney of Michigan summarizes mating-type phenomena in *Paramecium aurelia* and some of the recent mating-type work from Sonneborn's laboratory. C. B. Metz of Florida State compares mating-type substances in *Paramecium* and other ciliates with those found in Metazoa. Extensive chapter bibliographies are included.

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